PUBLIC DOCUMENT . . . . No. 4.

FIFTY-THIRD

ANNUAL REPORT OF THE SECRETARY

OF THE

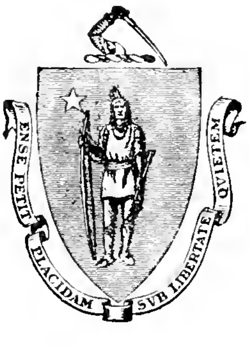
MASSACHUSETTS

STATE BOARD OF AGRICULTURE,

TOGETHER WITH THE

EIGHTEENTH ANNUAL REPORT OF THE HATCH EXPERIMENT STATION OF THE MASSACHUSETTS AGRICULTURAL COLLEGE.

1905.



BOSTON:
WRIGHT & POTTER PRINTING CO., STATE PRINTERS,
18 Post Office Square.
1906.

Approved by

The State Board of Publication

TABLE OF CONTENTS.

State Board of Agriculture, 1906.

Members ex Officio.

His Excellency CURTIS GUILD, Jr.
His Honor EBEN S. DRAPER.
Hon. WM. M. OLIN, *Secretary of the Commonwealth.*
KENYON L. BUTTERFIELD, M.A., *President Massachusetts Agricultural College (after July 1).*
C. A. GOESSMANN, Ph.D., LL.D., *Chemist of the Board.*
AUSTIN PETERS, M.R.C.V.S., *Chief of the Cattle Bureau.*
ALFRED AKERMAN, M.F., *State Forester.*
J. LEWIS ELLSWORTH, *Secretary of the Board.*

Members appointed by the Governor and Council.

	Term expires
WARREN C. JEWETT of Worcester,	1907
WILLIAM R. SESSIONS of Springfield,	1908
FRANCIS H. APPLETON of Peabody,	1909

Members chosen by the Incorporated Societies.

Amesbury and Salisbury (Agr'l and Hort'l),	J. J. MASON of Amesbury,	1909
Barnstable County,	JOHN BURSLEY of West Barnstable,	1907
Blackstone Valley,	SAMUEL B. TAFT of Uxbridge,	1909
Deerfield Valley,	E. P. WILLIAMS of Ashfield (P. O. Buckland),	1908
Eastern Hampden,	O. E. BRADWAY of Monson,	1909
Essex,	JOHN M. DANFORTH of Lynnfield (P. O. Lynnfield Centre),	1908
Franklin County,	JOHN S. ANDERSON of Shelburne,	1907
Hoosac Valley,	A. M. STEVENS of Williamstown,	1909
Hampshire,	HENRY E. PAIGE of Amherst,	1907
Hampshire, Franklin and Hampden,	WM. A. BAILEY of Northampton,	1909
Highland,	HENRY S. PEASE of Middlefield (P. O. Chester, R. F. D.),	1908
Hillside,	RALPH M. PORTER of Cummington,	1908
Hingham (Agr'l and Hort'l),	EDMUND HERSEY of Hingham,	1909
Housatonic,	EDWIN L. BOARDMAN of Sheffield,	1909
Marshfield (Agr'l and Hort'l),	H. A. OAKMAN of North Marshfield,	1909
Martha's Vineyard,	JOHNSON WHITING of West Tisbury,	1907
Massachusetts Horticultural,	WM. H. SPOONER of Jamaica Plain,	1909
Massachusetts Society for Promoting Agriculture,	N. I. BOWDITCH of Framingham,	1909
Middlesex North,	GEO. W. TRULL[1] of Tewksbury (P. O. Lowell, R. F. D.),	1907
Middlesex South,	ISAAC DAMON of Wayland (P. O. Cochituate),	1908
Nantucket,	H. G. WORTH of Nantucket,	1909
Oxford,	W. M. WELLINGTON of Oxford,	1907
Plymouth County,	AUGUSTUS PRATT of North Middleborough,	1908
Spencer (Far's and Mech's Assoc'n),	H. H. LEACH of North Brookfield (P. O. Spencer),	1907
Union (Agr'l and Hort'l),	ALBERT H. NYE of Blandford (P. O. Russell),	1907
Weymouth (Agr'l and Ind'l),	QUINCY L. REED of South Weymouth,	1909
Worcester,	WALTER D. ROSS of Worcester,	1908
Worcester East,	W. A. KILBOURN of South Lancaster,	1909
Worcester Northwest (Agr'l and Mech'l),	ALBERT ELLSWORTH of Athol,	1907
Worcester South,	C. D. RICHARDSON of West Brookfield,	1907
Worcester County West,	J. HARDING ALLEN of Barre,	1908

[1] Successor of Mr. Henry S. Perham, who died February 25.

THE FIFTY-THIRD ANNUAL REPORT

OF THE

SECRETARY

OF THE

STATE BOARD OF AGRICULTURE.

To the Senate and House of Representatives of the Commonwealth of Massachusetts.

The year 1905 has been an important one in the agricultural history of the Commonwealth, though remarkable for steady progress and general prosperity rather than for developments of a sensational character. The work of the Board has been carried on with the usual energy, and has been, as a whole, more than usually successful, as will be shown by the story of the detail work in the various departments, set forth in this report under the various headings. We have been alert to do all that appeared possible for the advancement of agriculture, and shall hope for continued and increased opportunities for usefulness in the future.

Generally speaking, the year was a profitable one for the farmers of Massachusetts. The potato crop was practically a failure where unsprayed, but where grown under these conditions it is not sufficiently a leading market crop to make much difference in the gross receipts of our farmers. Onions also were below the average in some sections, but other crops generally gave bountiful yields. Better prices ruled for dairy products than for several years past, and, owing to the good pasturage which continued throughout the season, they were economically produced in most instances. The hay crop was nearly a normal one, and Indian corn was unusually productive, both of grain and stover, so that well-filled barns and silos were the rule. Poultry products brought

good prices throughout the year, and grain food promises to be somewhat lower this winter than for several years. Market gardeners had good crops, and received average prices. The apple crop was slightly larger than usual in non-bearing years, and brought very high prices. Peaches yielded heavily, but prices were very low, reducing anticipated profits materially. Other fruits and berries did well, so that our horticulturists generally had a good year.

In the highly specialized condition of agriculture in Massachusetts there is one feature of the farmer's equipment that is essential to success, — he must be a thoroughly up-to-date business man, as well as a skilful grower of the products of the soil. This lesson has been one of the hardest which our farmers have had to learn, but there are signs that its importance is now being appreciated. The necessity for clean culture, good fertilization and the production of a choice article demonstrated itself, being constantly before the eyes of every tiller of the soil. It has not been so easy for many to see that a crop well grown has only half fulfilled its mission, — that it must be well sold, also, to bring the full measure of success.

Nature is kind to those who follow her, and even with old-fashioned hit-or-miss methods, the proportion of actual failures is smaller than in most other lines of business; in fact, there is no other line where business could be carried on year after year without a cash book, without taking account of stock or striking a balance. These processes are just as essential to the best success in the case of the farm factory as in that of any other producing establishment, and it is just here that many of our otherwise best farmers fail. Too many never know which of their crops or animals are profitable and which unprofitable, keeping no accounts, and often selling the very animals which should have been retained, not knowing their excellence.

The milk scales and the Babcock tester should be as essential a part of the equipment of every dairy farm as the very milk pails themselves, and should be used regularly, though not necessarily as often. Where poultry is a source of farm revenue, an accurate egg record should be kept. I would

not recommend that a separate account be kept with every crop, but all items should be entered in the cash book, and sufficient time devoted to its study to enable the farmer to determine which crops have been profitable and which unprofitable.

Success *always* comes to the farmer who is a good business man as well; there is no exception to this rule. There can be no line, therefore, which this Board can follow and emphasize, in its public meetings and institutes and privately by the example and precept of its members, to better advantage to our agriculture than this, of advocating the use of modern business methods in farm operations.

Changes in the Board.

On April 24 last the Board lost by death one of its oldest and most useful members. Henry H. Goodell, M.A., LL.D., became a member of this Board, *ex officio*, on his election to the presidency of the Massachusetts Agricultural College, in June, 1886.

Changes in membership resulting from elections by the several societies will be given in the report of the committee on credentials in the proceedings of the annual meeting. Members retiring because of expiration of term of service are: J. F. Burt of the Hampshire, Franklin and Hampden Agricultural Society; Charles H. Shaylor of the Housatonic Agricultural Society; and Henry A. Turner of the Marshfield Agricultural and Horticultural Society.

Meetings of the Board.

The summer meeting of the Board was held at Lowell, July 25, 1905, on the grounds of the Middlesex North Agricultural Society, with demonstrations of practical matters of interest to farmers as the main feature. The mixing and preparation of Bordeaux mixture, the most approved kinds of fruit packages, the selection of cattle for dairy and beef purposes, the Babcock test, the sanitary handling of milk and the killing and dressing of poultry for market were all demonstrated and explained in full view of a large audience by competent experts. After an excellent dinner, provided

by the Dracut Grange, Hon. N. J. Bachelder, ex-governor of New Hampshire, and now Master of the National Grange, gave an interesting address on the subject "Matters of importance in rural betterment." The afternoon was devoted to a visit to the farm of Mr. C. I. Hood, and an inspection of his fine stock of Jersey cattle and Berkshire swine. The meeting is reported in detail elsewhere in this volume.

The public winter meeting for lectures and discussions was held at Worcester, at the invitation of the Worcester Agricultural Society and the Worcester County Horticultural Society, and was well up to the standard of these meetings. While the attendance was not what it should have been, when the central location of the place of meeting and the high order of lectures provided is considered, it was nevertheless as large as usual, and of unusually high quality in mental grasp and alertness. Those attending the meeting were invited to visit the farm of Mr. Chas. W. Wood of Shrewsbury on the afternoon of the last day. Many availed themselves of this privilege, to their great satisfaction. The lectures and discussions of the meeting will be found printed in this volume.

The annual business meeting of the Board was held at Boston, Jan. 9 and 10, 1906, and special business meetings were held in connection with the summer and winter meetings. The minutes of this meeting, with reports of committees, are included in this volume.

Agricultural Societies.

Owing to the unfavorable weather of the first half of September, the agricultural societies, as a whole, had a less successful year financially than has been the case of late, though a considerable number of the fairs held under these adverse conditions resulted without actual loss. One society, the Hoosac Valley, held its first fair after a suspension of several years, and reports a very successful year financially. Judging from the reports of inspectors, the fairs appear to have been successful from the most important point of view, — that of their influence on the improvement of agriculture. Very few objectionable features found their way onto the grounds, and these were at once suppressed.

I would recommend to the societies that each and all of them give careful consideration to the question whether the time has not come for them to give up the engaging of attractions not of an agricultural nature, and confine their attention to a strictly agricultural fair. I recommend this from a business standpoint, and not because the agricultural features are at all neglected in those fairs where much money is expended for attractions. The societies were established for the improvement of agriculture, and the other features which have been added to the exhibitions from year to year have been introduced solely with the idea of attracting larger attendances and making the fairs more profitable. It is my belief that these features defeat their own ends in many cases, costing far more than they bring in at the gate in added admission fees. There are in every community many persons interested in agriculture, who will attend an agricultural fair for its agricultural features alone. The special attractions, to be profitable, must attract a sufficient number of others, who go merely to be amused and would not go without these attractions, to pay for themselves and leave a margin of profit. The only way for a society to be sure as to whether they are actually profitable and necessary is to hold one fair without them, and note results. The experience of the ten or twelve societies that do without them, or with only a slight expenditure along these lines, would seem to indicate that their policy was more nearly that of good financial management than that pursued by their sister corporations.

I would renew my recommendation of last year, that the societies establish sinking funds to tide them over years of bad weather; also, that for a careful overhauling of their premium lists. Too much money is now expended in premiums for breeds unworthy of encouragement under our conditions, and too little for premiums for those worthy of encouragement. In my judgment, for instance, there are but four, or at most five, breeds of poultry adapted to farm conditions in Massachusetts, and not all the varieties of these breeds are of economic value. How much better it would be to treble or quadruple the premiums to be paid for specimens of these breeds, and cut out altogether offers of premi-

ums for other breeds and varieties. The same principle is applicable to other kinds of live stock, and to fruits and vegetables as well. Societies could do much for agriculture by reverting to an old custom, and offering premiums for crops grown under best conditions, the committees to visit these crops in the field and make their awards on the whole crop, rather than for single specimens or a limited number of specimens exhibited in the hall of the society. More can be done for the dairy interests by premiums for competitive tests of milk and butter production than by premiums for ideal shape and fancy points.

Expert judges are required to be employed by the societies at the present time, and I would recommend that these judges be engaged from outside the territorial limits of the society, and that they should not be members of it, — at least, in the case of those employed in the live stock and poultry classes.

Farmers' Institutes.

The work of the year in this line has been the most successful since the institution of these meetings. The appropriation for the support of this work, together with that in other lines, was increased $300, making an aggregate of $3,000, only about one-half of which, however, is applied to farmers' institutes. This increase enabled us to hold an increased number of meetings, and also to do something in demonstration work. The field meeting of the Board at Lowell is reported under another heading, and does not require mention here. Another demonstration was held at the New England fair, at Worcester, and proved very successful and interesting.

Four circuits of institutes were held during the year, with Prof. J. W. Sanborn of New Hampshire, Dr. J. L. Hills of Vermont, Prof. John Craig of New York, and Prof. C. S. Phelps of Connecticut, as speakers.

These meetings proved to be very instructive, and enabled the societies to hear speakers from a distance who could not otherwise have been engaged. We shall repeat the practice during 1906, with Dr. George M. Twitchell of Maine, Dr. Chas. D. Woods, director of the Maine Agricultural Experi-

ment Station, Prof. John Craig of Ithaca, N. Y., and possibly H. W. Collinwood, editor of the "Rural New Yorker," as speakers. They are all men well known to our farmers, either personally or by reputation, and several successful series of meetings are anticipated. They will not be engaged for single meetings at other times during the institute season.

In attendance and interest the institutes of the year have been by far the most successful ever held. No lecture has been delivered during the year of a general rather than an agricultural nature, except in one instance, where the expense was borne by the society. One hundred and twenty-five meetings have been held during the year, under the direction and control of this Board, with 153 sessions. All the societies represented on the Board have held 3 or more institutes, except the Massachusetts Society for Promoting Agriculture, which is represented on the Board by special act, and holds no institutes, while 8 societies have held 4 or more. Sixteen other meetings have been held in localities not entirely covered by societies represented on the Board, and where there is a demand for such meetings. The average attendance for the year has been the largest since records of attendance have been kept, being 125 per session, as against 109 per meeting last year, 102 for 1903, 104 for 1902, 107 for 1901, 91 for 1900 and 94 for 1899. This increase is the more remarkable, as the attendance is computed on the new system adopted by the National Association of Farmers' Institute Workers, — that is on the session basis, instead of by the old method of taking the largest attendance at a two-session meeting, and adding half the attendance at the other session thereto. The total attendance at the 153 sessions was 19,172, also the largest on record. At 8 of these sessions the attendance was 300 or more; at 18, from 200 to 299; at 53, from 100 to 199; at 49, from 50 to 99; and at 25 it was less than 50.

In spite of the satisfactory condition of the work and the improvement shown, I believe that we shall not live up to the measure of our opportunities and responsibilities until the work is placed on a similar basis to that of the Dairy Bureau, with a largely increased appropriation. Then we

can develop the work as it should be in those places where it is now weak, and do something more systematic and thorough in demonstration work. To this end, I recommend that the Board ask for legislation along this line.

Nursery Inspection.

This work has gone along smoothly under the direction of the efficient nursery inspector elected by this Board, and he is able to report that 118 nurseries have been inspected and have received certificates; while 1 is so badly infested that all stock is fumigated; and at another no business is done, owing to the death of the owner. A fruitful source of infestation is the presence of insect pests on adjoining premises; and I would recommend that the law be so amended as to give the Nursery Inspector authority to order the destruction of infested trees or shrubs where they are likely to endanger stock grown for sale, in nurseries or otherwise. Some additional provision, whereby there may be an adequate inspection of nursery stock for the brown-tail moth, also appears to be imperative. Possibly this might be entrusted to the superintendent of the work against the gypsy and brown-tail moths, rather than to the Nursery Inspector. The report of the Nursery Inspector is printed in this volume.

Dairy Bureau.

The efficient and economical management of this Bureau, carried on as it is directly under the management of the Board, shows what might be accomplished in all departments of agricultural work with a similar system. The work of the general agent has been faithful, and shows excellent results for the year. As in 1901, more inspections have been made than ever before, and fewer infractions of the laws relating to dairy products discovered. The educational work accomplished during the year has also been of a high order. An article by General Agent Harwood, in our October Crop Report, on "Clean milk," was remarkable for moderation and breadth of treatment, and should be carefully considered by every producer and handler of milk.

Cattle Bureau.

This Board and its secretary has no control over this Bureau, though it is denominated in the law creating it as a Bureau of the State Board of Agriculture, — certainly an extraordinary condition of affairs. The report of the Chief of the Cattle Bureau is by law included in this volume, and will be found printed elsewhere.

State Forester.

The State Forester is made a member of this Board by the law creating the office, which also provides that his report be printed in this volume. In my report of last year I pointed out certain defects in the law, in my judgment, nor has the additional experience of the year led me to modify the strictures I then passed in any particular.

Massachusetts Agricultural College.

This institution suffered a severe loss during the year by the death of its president, Henry H. Goodell, M.A., LL.D., on April 24, 1905. Dr. Goodell had given the best years of his life to the college, and under his efficient guidance it had grown from humble beginnings to a high place among the educational institutions of the Commonwealth and the nation. Those who knew him best loved him most and best appreciated his sterling qualities of heart and mind.

During the year the new horticultural building has been erected, and is now in use. Other buildings are imperatively needed by the college, notably a building for the botanical department, greenhouses, and a new barn to take the place of the one destroyed by fire. These buildings will be asked for from the General Court by the Board of Trustees, making, with other necessary improvements, an extensive budget, but one every item of which is essential to enable the college to fulfil its mission as an educator of the youth of the Commonwealth. I would urge upon the Legislature the necessity of dealing with our college in a liberal spirit, and would call the attention of the members of the Board to the duty incumbent upon each of them of making sure that his local senator and representative fully understand the situation.

The total attendance at the college is the largest in its history, and improved facilities are imperatively required. The State must deal wisely at this time, and not cripple the development of this institution, at the beginning of what promises to be a great expansion and increase of usefulness, through any mistaken sense of economy.

At their annual meeting the Board of Trustees elected Kenyon L. Butterfield, president of the Rhode Island College of Agriculture and Mechanic Arts, president of the Massachusetts Agricultural College. President Butterfield comes well recommended, and has a great field for effective work open before him.

The Gypsy and Brown-tail Moths.

The Legislature of 1905 passed an act establishing the position of State superintendent of the work against these pests, and the Governor appointed A. H. Kirkland, M.S., to that position. This act and the appointment under it, together with the present condition of the infested territory, are commented upon extensively in the report of the committee on gypsy moth, insects and birds, printed in this volume. I have no personal comments to add to the report of that committee. I have done what was possible during the year to interest the national government in the work. Congressman Roberts is very much interested in this matter, and has introduced a bill at the present session making an appropriation for the work. An extensive correspondence with him, which is still going on, assures me that he is thoroughly in earnest, and leads me to hope that something may be accomplished at this session. We can each one of us do much to keep up the agitation in this matter, and to see that the New England delegation in the national Congress fully understands the importance of the case, and the frightful menace that the presence of these pests holds out to our fruit and forestry interests.

Crop Reports.

The publication of monthly crop reports has been carried on as heretofore. The special articles included in these reports were: "The management of mowings," by Prof. Wm.

P. Brooks; "How to supplement a short hay crop," by Prof. Chas. S. Phelps; "Bush-fruits," by Prof. F. S. Card; "Practical poultry housing" (illustrated), by John H. Robinson; "Commercial pork making and pig raising in New England," by A. A. Southwick; and "Clean milk: suggestions for the average producer," by P. M. Harwood. Numerous calls were received for these bulletins during the year, and requests that they be sent regularly so frequent as to call for an increase of the edition from 3,900 for May to 4,300 for October. The supply of the issues containing the articles on bush-fruits and swine growing were exhausted almost at once, so great was the call; and at the present time there are but few copies of the other months available, with the exception of October. There is one drawback attending the popularity of this work, — the increased expense, making yearly greater calls upon the appropriation for "the dissemination of useful information in agriculture;" but we shall continue to develop it, nevertheless, confident that, if necessary, a larger appropriation will be forthcoming when needed.

Nature Leaflets.

The following illustrated nature leaflets were issued during the year: "The brown-tail moth;" "The gypsy moth" and "The garden toad," by A. H. Kirkland, M.S.; and "School gardens," "Planting and care of the school garden," "Crops for the school garden" and "Results of school gardening," by Mr. H. D. Hemenway.

It was found necessary to issue a second edition of the nature leaflets on "Spraying mixtures for insects and plant diseases," "Insects injuring lawns," "Owl friends," "Bird houses" and "Our friend the chickadee."

Extracts from the Trespass Laws.

In compliance with law copies of the extracts from the trespass laws were furnished on paper for posting in the post-offices of the State. Copies printed on cloth for outdoor use were furnished on application. The following table will show the number of individuals requesting posters, the number sent, and the variations from month to month during the year: —

Month.	Applications.	Copies sent.
January,	5	17
February,	4	17
March,	19	84 [1]
April,	78	370
May,	76	358
June,	51	253
July,	53	254
August,	63	292
September,	43	201
October,	45	210
November,	25	113
December,	13	65
Totals,	478	2,234

[1] In addition, 950 copies were supplied post-offices for posting, as provided by law.

Legislation.

The legislation of 1905 having reference to the Board of Agriculture or to the agricultural societies was: "An Act making an appropriation for exterminating contagious diseases among horses, cattle and other animals" (chapter 40); "An Act making appropriations for salaries and expenses in the office of the chief of the Cattle Bureau of the State Board of Agriculture" (chapter 59); "An Act making appropriations for salaries and expenses in the office of the State Board of Agriculture, and for sundry agricultural expenses" (chapter 70); "An Act to establish the salary of the general agent of the Dairy Bureau of the State Board of Agriculture" (chapter 155); "An Act relative to the Massachusetts Horticultural Society" (chapter 116); "An Act making an appropriation for a deficiency, in the appropria-

tion in the year nineteen hundred and four for the extermination of diseases among horses, cattle and other animals" (chapter 131); and a "Resolve to provide for preparing and printing a special report on the birds of the Commonwealth" (chapter 51).

Publications.

The following publications were issued by this office in 1905, most of which may be obtained on application: —

	Pages.	Number.	Date of Issue.
Agriculture of Massachusetts, 1904, .	791 [1]	15,000	June 8.
Farmers' institute pamphlet, . .	8	800	Jan. 7.
Crop Report No. 1, ...	40	3,900	June 3.
Crop Report No. 2, ...	40	3,900	July 5.
Crop Report No. 3, ...	40	3,900	July 31.
Crop Report No. 4, ...	40	4,200	Sept. 1.
Crop Report No. 5, ...	40	4,200	Oct. 2.
Crop Report No. 6, ...	40	4,300	Nov. 6.
Nature Leaflet No. 26, ...	4	2,500	March 14.
Nature Leaflet No. 27, ...	4	1,500	March 14.
Nature Leaflet No. 28, ...	8	1,000	May 31.
Nature Leaflet No. 29, ...	8	1,000	Oct. 11.
Nature Leaflet No. 30.	8	1,000	Oct. 11.
Nature Leaflet No. 31, ...	8	1,000	Oct. 16.
Nature Leaflet No. 32, ...	8	1,000	Oct. 16.

[1] Including seventeenth annual report of the Hatch Experiment Station of the Massachusetts Agricultural College, 178 pages.

There were also issued in pamphlet form the following excerpts from the "Agriculture of Massachusetts," 1904: "Producing and marketing of milk," by Mr. Frank B. Allen;

"The hay crop in Massachusetts," by Prof. Wm. P. Brooks; "The growing of mushrooms," by Dr. G. E. Stone; "Harvesting and marketing apples," by Prof. F. A. Waugh; "Breeds for the farm and farmers as poultry breeders," by Mr. John H. Robinson; "Bee keeping: how to meet its dangers and difficulties," by Mr. Burton N. Gates; and the special report on "The decrease of certain birds, and its causes," by Mr. Edward Howe Forbush: also the annual reports of the Chief of the Cattle Bureau, the Dairy Bureau, and the State Nursery Inspector.

Reprints of Nature Leaflets Nos. 4, 8, 14, 15 and 16 were also issued during the year.

LEGISLATIVE APPROPRIATIONS; BOARD OF AGRICULTURE.

Objects for which appropriated.	1905.		1906.[1]
	Appropriated.	Used.	Appropriated.
Bounties to societies,	$17,100 00	$16,911 00	$18,600 00
Salaries of secretary and clerks,	6,200 00	6,200 00	5,683 33
Travelling and necessary expenses of Board,	1,500 00	1,156 47	1,200 00
Lectures before the Board, etc.,	600 00	493 69	100 00
Dissemination of useful information in agriculture,	3,000 00	2,985 77	2,750 00
Travelling and necessary expenses of the secretary,	500 00	248 30	450 00
Printing 15,000 copies of "Agriculture of Massachusetts,"	6,000 00	5,790 96	5,800 00
Work of the Dairy Bureau, including salaries,	8,400 00	8,400 00	7,699 99
State nursery inspection,	1,000 00	994 97	1,000 00
Incidental and contingent expenses, including printing and furnishing extracts from the trespass laws,	1,100 00	1,044 31	900 00
Special report on the birds of the Commonwealth,	3,000 00	272 50	2,727 50[2]
Totals,	$48,400 00	$44,498 00	$46,910 82

[1] Appropriations for 1906 for eleven months, ending November 30 (Acts of 1905, chapter 211).

[2] Unexpended balance.

The Legislature of 1905 also appropriated $72,000 [1] to be expended under the direction of the Chief of the Cattle Bureau of the State Board of Agriculture for exterminating contagious diseases among horses, cattle and other animals.

Special Report on Birds.

Chapter 51 of the Resolves of 1905 provides "that there be allowed and paid out of the treasury of the Commonwealth a sum not exceeding three thousand dollars for preparing and printing, under the direction of the State Board of Agriculture, in an edition of five thousand copies, a special report on the birds of the Commonwealth, economically considered, to include the facts relating to the usefulness of birds and the necessity for their protection, already ascertained by the ornithologist of the State Board of Agriculture."

The ornithologist of this Board, Mr. Edward Howe Forbush, has the matter of the report well in hand, and it is expected that it will be available for distribution in the manner provided in the resolve, during the year. The report will be fully illustrated, and will be a very valuable addition to bird literature. I need hardly add that your ornithologist has had many years' experience with the birds, and is without question one of the foremost authorities on their economic relations.

Press Bulletins.

We have continued to issue these abstracts of our publications during the year, and desire to thank the press of the State as a whole for their kindly reception of them and the space devoted to them. This forms a valuable means of placing our educational publications before the people immediately upon their issue, and we shall continue to avail ourselves of it so long as these short bulletins meet with their present favor.

Agricultural Census.

I desire to call the attention of the farmers of the State to the census of agricultural products for 1905 soon to be taken by the Bureau of Statistics of Labor. They can add

[1] Including $5,000 for a deficiency in the appropriation in the year 1904.

much to the effectiveness of the work by preparing themselves in a measure for the visit of the enumerator, making some investigation as to the yields and value of their crops and the products of their flocks and herds. In this way they will be prepared to answer the questions asked them intelligently, making the work of the enumerator light, as well as their own, and contributing to an accurate and valuable census of the agricultural products of the Commonwealth.

Codification and Amendment of Laws.

There is no question but that the laws relating to the Board of Agriculture, the agricultural societies and the system of agricultural machinery in general might be improved by a systematic revision and codification. The Board would do well to consider the question, and be prepared to present a comprehensive plan for such a codification at no distant date. In my judgment such a measure should provide for the bringing of all the departments of the work of the State for agriculture under the direction of the Board. It should also provide for a thorough revision of all the laws relating to agriculture, and in particular allowing the agricultural societies to expend the money received as bounty from the Commonwealth in institute and demonstration work, the employment of expert judges, or in other ways for the improvement of agriculture, providing that these meet the approval of the Board. This would do away with the necessity of a society holding a fair, if in the judgment of its officers and officials of the Board of Agriculture it could do more effective work for agriculture in some other manner. There are numerous minor changes which would be found to be desirable, and which could be included in such an act without possibility of objection from any quarter.

Respectfully submitted,

J. LEWIS ELLSWORTH,

Secretary.

Boston, Jan. 9, 1906.

Summary of Crop Conditions, 1905.

The weather of May was so cold and dry that at its close all vegetation was very backward and much in need of rain. Pastures and mowings wintered well, but owing to the lack of rain there was little feed in pastures, and mowings were also backward, but with a good bottom growth. There was a fair bloom of apples for an off year, and the bloom of pears, peaches, cherries and plums was unusually heavy. Strawberries bloomed full, though late. There was very little injury from frosts. Few insects appeared, and did little damage. Spraying was practically confined to farmers making a specialty of fruit, and, while all use insecticides on their potatoes, comparatively few use fungicides to prevent rot. Farm help was fairly plenty; average wages, $20 per month with board, and $1.50 per day, or higher, without board. There was a slight increase in the acreage of corn and decrease in that of potatoes.

Insects did less damage than usual in June. Indian corn was from a week to ten days late, but of good color and growing fast. Haying was just beginning at the close of the month, with close to an average crop of good quality. The acreage of forage crops was materially increased. There were numerous reports of poor germination of potatoes, and the crop was uneven and backward. Early market-garden crops generally yielded well, with prices somewhat lower than usual. The flow of milk was well maintained, with prices for butter and butter fat higher than for some time. Dairy cows were somewhat easier to obtain than formerly, with prices a little lower. Pastures were short and dry the first of the month, but improving materially towards its close. Strawberries promised a fair crop; cherries were an

excellent crop; plums and pears promised only light yields: peaches set well; apples promised well for a non-bearing year.

Potato bugs were more common in July than for several years; other insects doing surprisingly little damage. Indian corn came forward rapidly with the warm weather of the month, and at its close was little below the normal. Much of the crop is used for the silo. The hay crop was somewhat below the average in quantity, but of excellent quality and secured in good condition. The acreage of forage crops was slightly increased, but needed rain at the close of the month. Market-garden crops were generally good, but not extra, with prices normal. No early potatoes were dug, but they generally promised well. Apples fell off in condition during the month. Pears and plums only light crops; peaches promised a good crop; quinces average; grapes and cranberries set well. Feed in pastures was in unusually good condition. Rye, oats and barley were good crops, both for grain and forage.

Indian corn advanced rapidly during August, and at its close was nearly up to the normal. Only two correspondents reported that sweet corn was raised for canning, but it is grown extensively as a late forage crop. Rowen did not promise an average crop, owing to drought and late cutting of first crop. Late potatoes threatened to be considerably below the normal, blight and rot having appeared. There was a slight increase in the acreage of tobacco and an excellent crop. Pastures were in unusually good condition. Apples dropped badly, but were above the average for an off year; pears only a light crop; peaches promised an unusually heavy yield; grapes set well; cranberries suffered from winter-killing, spring frosts and insect damage, and only promised a light crop. Oats were a heavy crop, with barley good for forage and the silo.

Indian corn did not ripen as rapidly in September as had been hoped, and much remained unsecured. An excellent growth of stover was reported, and a good growth of ears. The rains greatly improved rowen, but it still was somewhat below the normal, and much unsecured at the close of

the month. Fall seeding was delayed by wet weather, but that put in was in fine condition. Onions were considerably under a normal crop, and were of small size. Potatoes closely approached a total failure, with light yield and much injury from rot and grubs. Root crops generally promised well. Celery was doing well, though not especially forward. Other late market-garden crops generally promised well. Apples deteriorated, and a light crop of poor quality is all that was promised; pears were a fair crop; peaches yielded well, but suffered severely from rains, while prices ruled low; grapes generally yielded well; cranberries only a light crop.

The final report of the season, at the end of October, showed that, on account of the open fall and the absence of killing frosts, the corn crop was given ample opportunity to ripen, and the result was a crop considerably above the normal in value of stover and very nearly normal in value of grain. The weather was also very favorable for curing the stover. Ensilage corn also made a fine growth, and was secured in good condition in all sections. Root crops were generally reported to be good average crops, and they generally brought good prices where raised for market. Potatoes rotted badly, and the crop was almost a total failure for the State as a whole. Celery was a good crop, as were other late market-garden crops. Feed in pastures was uniformly good throughout the season, and, as a result, farm stock went into the barns in good flesh. The flow of milk was reported to be unusually well maintained for the season. Less fall seeding than usual was done, owing to continued wet weather in August and September, but that put in early was reported as in remarkably fine condition. Seeding after the rains made a good catch.

Prices of crops raised for market ranged considerably higher, as a whole, than for the past few years, probably in large measure because of shortage in some of the principal crops, as apples, potatoes, cranberries and onions. Of 147 correspondents answering the question as to prices for crops raised for market compared with former years, 6 spoke of them as lower than usual, 90 as average or above average

and 51 as higher than usual. Prices for dairy and poultry products ranged slightly above even the high levels reached in 1904.

Concerning the questions as to "most profitable crops" and "least profitable crops," 72 correspondents, less than a majority, considered hay to have been among the most profitable crops; 54, corn; 20, apples; 15, potatoes; 9, sweet corn; 8, oats; 8, tomatoes; 7, cabbages; 6, onions; 6, tobacco; and 5, milk; while 115 correspondents, an unusually large number to unite on any one crop, reported potatoes as among the least profitable crops; 17, apples; 7, onions; 4, hay; 4, cabbages; and 4, cranberries.

The general trend of prices indicated that farmers were generally well satisfied with the season. In the main, good crops were secured, and where shortages occurred prices ruled unusually high. Market gardeners generally had a profitable season, with good crops and average prices. Dairymen received prices averaging a little better than formerly; milk and butter fat were economically produced, by reason of good pasturage; and barns and silos were well filled in anticipation of winter. Poultry raisers received good prices for their products. Apples were as good a crop as could be expected in an "off year," and brought high prices. Peaches were a very heavy crop, with correspondingly low prices. Other fruits and berries gave fair to good yields, and brought average prices. On the whole, horticulturists should not complain of the season. Of the 149 correspondents answering the question as to profits, 80 considered the season to have been a profitable one, 20 an average season for profit, 13 fairly profitable, while 6 thought that it was above the average for profit and 30 that it was not a profitable season.

Massachusetts Weather, 1905.

[Compiled from Data furnished by the New England Weather Service.]

The weather of January was of the midwinter type, somewhat intensified, particularly with regard to temperature, the monthly mean ranging several degrees below the January normal in all sections, and the cold weather being continuous,

without the usual mild period. The precipitation, mostly snow, did not depart greatly from the monthly average, but the snow was badly drifted, thus impeding railroad and street car traffic.

February was a cold month, with a marked prevalence of fair weather, the monthly mean, 19.8°, being one of the lowest on record. The precipitation, averaging 1.67 inches, was much below the monthly normal, and mostly in the form of snow; but, owing to the low temperature, the ground was generally covered with snow throughout the month.

The weather of March was exceptionally pleasant for this month, there being an entire absence of the severe storms frequently prevalent. The temperature was lower than the average until the closing decade, when there was a sudden change from winter to spring-like weather. The snow and ice disappeared gradually, and there were no destructive freshets. Weather conditions were unfavorable to the flow of sap. At the close of the month the ground was generally bare.

April was very pleasant, there being no marked departures from the average in the several elements of temperature, precipitation and sunshine. The day temperatures were generally below the average, while the night temperatures did not fall as low as usual in April. The precipitation, while somewhat below the average, was well distributed. The weather conditions were generally favorable to farming operations.

May opened with cool weather until the 6th, when there was a marked rise, with temperatures above normal until the 12th. From that date to the 24th the weather was decidedly cool, the daily mean temperatures ranging from 2° to 10° below the normal. From the 25th to the close of the month higher temperatures prevailed. Frosts occurred from the 14th to the 24th, with some damage to tender vegetation. There was much cloudiness and unsettled weather, but also a marked and general deficiency in rainfall, it being but little over half of the normal amount for May. High winds also prevailed, adding to the droughty conditions.

During the first five days of June the nights were cool,

with only moderate day temperatures and little or no rainfall. From the 6th to the 8th cloudy weather and general rains prevailed, but the temperature continued low, with light frosts on the 9th. Following the 9th the temperature was higher and the nights were seasonably warm. On the 18th a period of cloudy weather began, extending through the 22d, with heavy rainfall, 2 inches or more in some sections. The temperature remained low, but with clearing weather rose to slightly above the normal. Considering the month as a whole the temperature averaged below normal, the rainfall much above normal, and the sunshine slightly below the usual amount.

Cool weather prevailed during the first four days of July, with showery, unsettled weather but from the 5th to the 20th high temperatures prevailed, both for the days and nights, with humidity from 15 to 20 per cent above the average. The warm weather was broken on the 21st, and comfortable conditions prevailed until the end of the month. The rainfall was exceptionally light, except in a few instances of several local storms, when heavy downpours of rain occurred. The month as a whole was very near the normal as regards temperature, the cool weather of the opening and closing days offsetting the warm period. The rainfall of the month was one of the smallest on record for July.

August opened cool and cloudy, with local showers. Following the 2d there was nearly a week of fair weather, with temperature ranging from 80° to 87° during the day. From the 8th to the 13th unsettled conditions prevailed, with local showers and thunderstorms. The 13th and 14th were clear, but the 15th and 16th were again stormy. From the 16th to the 24th generally clear weather prevailed, with light to moderate rains on the 24th and 25th, with generally fair weather until the close of the month. The temperature for the month as a whole was nearly normal, and the rainfall somewhat below normal, though not enough so to cause damage.

September opened with overcast, unsettled weather, followed by a general downpour on the 3d and 4th, the rainfall being remarkably heavy, exceeding in most instances

the normal fall for the month. Clear to partly cloudy weather followed to the 10th, after which there was a week of cloudiness, rains and fogs, with light rainfall. The temperatures of the month did not depart greatly from the September averages. The day readings were somewhat below seasonal, while the nights were generally warmer than usual. Cool spells were general on the 14th and 15th and also the 26th and 27th, with light frosts in the interior. As a whole, the weather was very unpleasant for September.

The weather throughout October was unusually pleasant, and in some of its elements quite abnormal. There was almost continuous sunshine, there being only four days on which the skies were wholly overcast. Light showers occurred in some part of each week, but rainfall was small in about all instances, and in many localities the amounts were too small to measure. At Boston it was the smallest, with a single exception, 1897, of any October in the past thirty-three years. Taking the month as a whole, the temperatures ruled high, and the average daily excess was about 2°. During the period from the 15th to the 20th the mercury ranged unusually high, reaching the 80's in some localities. The closing decade was, however, quite cool, with the temperatures on several days decidedly below the seasonal average, during which killing frosts occurred, and in many sections freezing weather was experienced. Generally speaking, the weather of the month was of the type popularly known as "Indian summer," *i.e.*, warm and sunny, with light winds, clear to hazy skies and beautiful sunsets.

November, like October, was characterized by remarkably pleasant weather, with an abundance of sunshine. There was a general and quite marked deficiency in the precipitation, which was, however, well distributed through the month and over the territory. During the passage of cold waves on the 13th and 14th and the 29th and 30th the temperature fell unusually low for the time of year, and the monthly means, as a rule, were somewhat below normal. The chief storm of the month was that of the 28th and 29th, during which general copious rains occurred in most sections, and high winds and gales prevailed along the coast, with

hurricane force in some southern sections. The fair, sunny weather, with moderate temperatures, was very favorable to farming operations and other outdoor pursuits, and maintained meadows and pastures in good condition, supplying pasturage in many sections till near the close of the month. The beginning of the winter season, as a rule, found farming interests in a very satisfactory condition.

December, as a whole, was a very pleasant month for the season. The temperatures were moderate, the monthly means being above the average in all sections. The precipitation was about the average, and mostly in the form of rain. Snow, however, fell in light to moderate amounts in all sections of the State. Four well-defined storms passed over the section during the month, namely, those of the 2d and 3d, 10th and 11th, 22d and 23d, and 29th and 30th. These caused general precipitation, chiefly rain, except that of the 10th and 11th, during which nearly all of the snowfall of the month occurred. High winds and destructive gales accompanied the storms of the 10th and 11th and 22d and 23d. Owing to the general mildness of the weather, there was little frost in the ground, particularly in eastern and southern sections. The moderate weather was very favorable to outdoor work, and there was more or less plowing done in many sections. The warm weather was, however, unfavorable to the ice interests.

Meteorological Observatory of the Hatch Experiment Station (Massachusetts Agricultural College), Amherst.

[Latitude, 42° 23′ 48.5″ N.; longitude, 72° 31′ 10″ W. Height of barometer above ground, 51 feet; above sea level, 273.5 feet. Height of wind instruments, 72 feet.]

Annual Summary for 1905.

Pressure (in Inches).

Maximum reduced to freezing, 30.54, December 1, 11 A.M.
Minimum reduced to freezing, 28.91, April 6, 10 A.M.
Maximum reduced to freezing and sea level, 30.86, December 1, 11 A.M.
Minimum reduced to freezing and sea level, 29.22, April 6, 10 A.M.
Mean reduced to freezing and sea level, 30.019.
Annual range, 1.64.

Air Temperature (in Degrees F.).[1]

Highest, 93.0, July 10, 2.30 P.M.
Lowest, —13.0, January 24, 7.30 A.M.
Mean, 45.8.
Mean of means of max. and min., 46.1.
Mean sensible (wet bulb), 41.1.
Annual range, 106.0.
Highest mean daily, 81.5, July 18.
Lowest mean daily, 1.7, January 5.
Mean maximum, 57.1.
Mean minimum, 35.0.
Mean daily range, 22.1.
Greatest daily range, 45.0, June 9.
Least daily range, 3.0, June 12.

Humidity.

Mean dew point, 37.3.
Mean force of vapor, .365.
Mean relative humidity, 76.5.

Wind.—Prevailing Direction, West.
Summary (Per Cent).

West, north-west, 13.
South, south-west, 11.
South, 10.
North-west, 9.
West, 8.
Other directions, 49.
Total movement, 46,442 miles.
Greatest daily movement, 475 miles, January 4.
Least daily movement, 1 mile, June 22.
Mean daily movement, 127 miles.
Mean hourly velocity, 5.3 miles.
Maximum pressure, per square foot, 23.5 pounds = 69 miles per hour, January 4, 9 A.M., W.N.W.

Precipitation (in Inches).

Total precipitation, rain or melted snow, 38.80.
Number of days on which .01 or more rain or melted snow fell, 122.
Snow total, in inches, 40.0.

Weather.

Mean cloudiness observed, 49 per cent.
Total cloudiness recorded by sun thermometer, 1,977 hours = 44 per cent.
Number of clear days, 130.
Number of fair days, 128.
Number of cloudy days, 107.

Bright Sunshine.

Number of hours recorded, 2,477 = 56 per cent.

Dates of Frosts.

Last, May 24.
First, September 15.

Dates of Snow.

Last, May 1.
First, November 9.
Total days of sleighing, 64.

Gales of 50 or More Miles per Hour.

January 4, 69 miles, N.N.W.; 7, 52 miles, E.S.E.; 25, 60 miles, N.N.W.; 26, 50 miles, N.W.
February 18, 60 miles, W.
March 19, 57 miles, N.E.
April 17, 60 miles, W.
December 30, 53 miles, W.

[1] Temperature in ground shelter.

J. E. OSTRANDER, *Meteorologist.*
C. H. CHADWICK, *Observer.*

MEETING OF THE EXECUTIVE COMMITTEE

OF THE

BOARD OF AGRICULTURE

1905.

MEETING OF THE EXECUTIVE COMMITTEE, ACTING FOR THE BOARD.

BOSTON, Feb. 23, 1905.

The executive committee met at the office of the secretary in Boston this day at 11.30 A.M., a majority of the members being present.

A communication was read from Mr. O. E. Bradway, delegate from the Eastern Hampden Agricultural Society, stating that said society and the people of Palmer wished to be relieved of the holding of the public winter meeting of the Board in Palmer in December next, as voted by the Board at the annual meeting, on account of inability to furnish required hotel accommodations.

Voted, To grant the request.

Voted, That the invitation extended by the Worcester Agricultural Society and the Worcester County Horticultural Society to hold the meeting in Worcester be accepted.

Voted, That Mr. Ross be added to the local committee of arrangements for the meeting.

Voted, That Hon. Wm. R. Sessions be appointed inspector to the fair of the Hoosac Valley Agricultural Society at North Adams.

Voted, That the 1905 dates for the fair of the Massachusetts Horticultural Society be changed to September 14, 15, 16 and 17.

Voted, That the request of the Bristol County Agricultural Society for change of dates to September 4, 5 and 6 be denied, on account of interference with dates of a neighboring society.

SPECIAL BUSINESS MEETINGS

OF THE

BOARD OF AGRICULTURE

1905.

SPECIAL BUSINESS MEETINGS OF THE BOARD.

A special business meeting of the Board of Agriculture was held at the New American Hotel, Lowell, on Monday, July 24, 1905, at 7.30 o'clock P.M., Second Vice-President Pratt presiding.

Present: Messrs. Akerman, Anderson, Bradway, Burt, Danforth, Albert Ellsworth, J. L. Ellsworth, Kilbourn, Lane, Jewett, Mason, Nye, Paige, Pease, Perham, Peters, Porter, Pratt, Richardson, Ross, Shaylor, Turner, Wellington, Williams and Worth.

Dr. Peters, chief of the Cattle Bureau, submitted his seventh semi-annual report, which was accepted.

Voted, On request, to change the dates of the fair of the Amesbury and Salisbury Agricultural and Horticultural Society to September 26, 27 and 28.

A special business meeting was held at Horticultural Hall, Worcester, Tuesday afternoon, December 6, after adjournment of the session of the public winter meeting, First Vice-President Sessions presiding. Most of the members of the Board were present.

The committee on gypsy moth, insects and birds presented and read its annual report, which by unanimous vote of the Board was accepted and adopted.

The secretary read a letter from Governor-elect Guild, stating that on account of illness he would be unable to attend the reception on the morrow. On motion of Mr. Jewett, it was

Voted, To send a letter of sympathy to the Governor-elect.

SUMMER FIELD MEETING

OF THE

BOARD OF AGRICULTURE,

AT

LOWELL.

JULY 25, 1905.

SUMMER MEETING OF THE BOARD, AT LOWELL.

The summer field meeting of the Board of Agriculture was held at the grounds of the Middlesex North Agricultural Society, Lowell, on Tuesday, July 25, 1905.

At 9.30 o'clock A.M. Professor Waugh of the Massachusetts Agricultural College showed and explained various kinds of fruit packages. He then illustrated and explained the preparation of Bordeaux mixture for the prevention of fungous diseases. There was also a demonstration of spraying by a large spraying apparatus, with power generated by an engine.

Mr. P. M. Harwood, general agent of the Dairy Bureau, demonstrated the workings of the Babcock milk tester, and tested samples of milk brought to him. He also exhibited and explained several makes of milk pails.

Mr. Wm. H. Caldwell of Peterboro, N. H., gave a short address on the points to look for in the selection of a dairy cow, using three cows in his demonstration.

Mr. W. D. Rudd of Boston spoke of the chicken the market wants; and Mr. Wm. Murphy, also of Boston, illustrated the killing and picking of chickens for market.

Dinner was served in Agricultural Hall by the ladies of Dracut Grange, and 350 or more sat down to a dinner excellent in quality and ample in supply.

At the conclusion of dinner, at 1 o'clock, Secretary Ellsworth introduced Mr. Henry S. Perham of Chelmsford, a member of the Board, as toastmaster.

The principal address was by Ex-Gov. N. J. Bachelder of New Hampshire, whose subject was "Matters of importance in rural betterment." Brief remarks were made by Worthy Master Hadley of the New Hampshire State Grange, by Worthy Master Ladd of the Massachusetts State Grange, and by Secretary Ellsworth.

Shortly after 2 o'clock a large party of men and women present were conveyed in special electrics to the C. I. Hood farm in Tewksbury, to view the fine herd of Jersey cattle there, to note the sanitary arrangements, care given the animals, etc., under the personal direction of Messrs. C. I. Hood, Julian Hood and Superintendent Dodge. The return to Lowell was made in time to enable the visitors to take the late afternoon trains home.

The day proved an excellent one for the demonstrations, and the programme was carried out with entire success. It was estimated that more than 500 persons attended this field meeting, which has been referred to by the press as the best meeting the State Board of Agriculture ever held.

An abstract of the address of Ex-Governor Bachelder follows.

MATTERS OF IMPORTANCE IN RURAL BETTERMENT.

BY EX.-GOV. N. J. BACHELDER, CONCORD, N. H.

It is somewhat unusual for a citizen of New Hampshire to attempt to instruct or entertain a Massachusetts audience upon any subject whatever, for we have become accustomed to look to Massachusetts as the fountain head of all that is good in art, literature and refinement, and the source of all that has actuated the formation of political parties and religious creeds. Why should we not look to Massachusetts for all that is sound and reliable in agricultural teaching? I give your State as much credit for leadership in agriculture as in the other matters to which I have referred, and it is with much embarrassment that I attempt to say a word upon this occasion. I find some excuse for attempting it in the fact that the lines separating the New England States are not very broad or very high; and while we are citizens of our respective States, we are citizens of New England in a fuller sense than ever before. Subdivisions of the town, county, State and country have less significance than formerly, and our thoughts and interests should be broadened in the same degree. The lines encircling the school district seemed about as distant from the home of our grandparents as do the lines bounding our country beyond the Philippines to the present generation; and our interest in rural betterment should be of a similar comprehensive nature. We should not inquire as the man prayed for blessings, upon "me and my wife, my son John and his wife, us four and no more," but as to how we can better the conditions of agriculture in the nation, trusting to our own efforts to reap the benefits that will come to all engaged in it. Our aim is not to improve conditions in our own town or our own State, or even in our own industry, but to improve conditions every-

where; and for a few moments we will forget that we are citizens of Massachusetts or New Hampshire, but Americans in the broadest sense of the word.

Agriculture the Basis.

We hear a great deal about the importance of agriculture as the great basic industry of the country, upon which all other industries depend; but comparatively few people appreciate the full significance of such a statement. The volume of agricultural products can be expressed in figures and the number of people engaged in agricultural pursuits stated, both of which are so vast as to be almost staggering, and yet convey no comprehensive idea of the important place that agriculture fills in the business of the country, because its relation to other industries is not therein indicated. The dependence of manufacturing, transportation and commercial affairs for prosperity upon the prosperity of agriculture is the vital point in the great supremacy of this industry. The patriotic statesman who most sincerely desires to contribute to national wealth and national prosperity will most effectually accomplish his purpose by contributing to the promotion and development of agriculture.

To do this means something more than producing crops and feeding stock, for it means making such efforts as will enable every farmer to produce crops and feed stock at an increased profit. Those men and women who have worked out difficult problems in agriculture and established principles that have become a science are entitled to as much honor as those who have manifested their patriotism in the discussion of important public questions or directed great public matters. In a smaller way, those who have been leaders in the adoption of scientific methods in the operation of their farms, furnishing object lessons for those inclined to follow rather than lead, are as much entitled to be termed patriots as those who have rendered the people loyal service in the management of public affairs. A person can become a patriot in building up agriculture, either working for himself or for the advantage of others, as well as in the supervision of affairs which depend upon agriculture for a foundation.

Up-to-Date Methods.

An important matter in rural betterment is the adoption of progressive, up-to-date methods. If there is a farm in New England of good soil workable by machinery that is not producing as good crops as ever in the past, it is because it has been improperly handled. There is no more reason for this class of farms wearing out than for roads wearing out. When a person runs in debt for a farm and pays for it in eight years from legitimate farming, and puts $10,000 in the savings bank, and another person in the same neighborhood with the same kind of a farm allows it to be taken by the mortgagee within four years; when one person in a neighborhood doubles the production of his farm in four years from the resources of the farm, and another allows the products to deteriorate 50 per cent in the same time; when one person makes $10,000 in ten years breeding and selling cattle upon a remote New England farm, and another loses a like amount that he inherited in the same business in the same time, — there is evidence of some other fault with farming than unfavorable natural conditions. There is not an acre of productive soil in New England that cannot be worked at a profit if progressive, up-to-date methods are practised. One of the chief reasons for decline in agriculture in the past was the failure to change methods in accord with changed conditions. There is now a strong tendency towards New England farms with the adoption of modern methods of farming. The science of agriculture is becoming rapidly established, and its application to the cultivation and fertilization of the soil, to the breeding and feeding of animals, to the suppression of insect diseases and fungous pests and to handling and storing farm products, is already working a revelation in agriculture that will be far-reaching in results. It is our duty to recognize and promote this matter, in the interest of rural betterment.

The Summer Business.

The rural sections of New England are peculiarly adapted to the establishment of summer homes; and during the past ten years I have given my best thought and most earnest

effort to promoting this movement. I am aware that the summer-home citizen does not add materially to the agricultural production of a State, but he does add very materially to the financial welfare of the farmer. I can refer you to towns in which the value of the entire real estate has doubled in ten years from the effect of the summer business; to towns where there is a market at better prices during two or three months in the year for about every product of the farm than are obtained at retail in Faneuil Hall; and to instances where a little boy has received $500 in a season for fir-balsam pillows, the material for which was gathered from his father's forest; and where a little girl has received $300 from the sale of sweet peas grown in her garden. The expenditure of vast sums of money in improving old farms, as was done by a worthy citizen of Lowell in improving a farm in one of our country towns to the amount of $100,000, enables about every person in the town to derive financial benefit. Every occupation and profession is included in the list of beneficiaries, for not only carpenters, masons, painters and blacksmiths come in for a share, but traders, doctors, lawyers and ministers derive benefit therefrom. The money that these people earn helps to buy the farmer's products as well as the money that pays for supplies for the summer resident's family. The sum of money annually left in New Hampshire from the summer business is estimated at $8,000,000, — an amount equal to the value of the annual hay crop of the State. The important matter in this connection is to stimulate our farmers to cater to this market to a greater extent, and to induce a few hundred ambitious, energetic farmers to engage in poultry raising, market gardening, fruit growing and cream production, with this market especially in view. The summer business is bound to ultimately add to agricultural prosperity, as well as to the social and æsthetic advancement of the locality. I have referred specially to the section of New England with which I am most familiar, and the same possibilities exist in a greater or less degree in the rural sections of all the New England States.

Agricultural Colleges.

Rural betterment demands a sincere interest in this direction by the managers of agricultural colleges, and a recognition by them of the advantages to be derived by agriculture and the country from the training of men to engage in farming. Short courses should be made prominent and popular, and the boys taken from the farm without rigid requirements in scholarship; and the influence of the institution during their stay should be such that they will return to the farm enthusiastic in the work. Those institutions open to the admission of girls should provide them with training in the important matter of housekeeping and home-making. It is as important that they know how to make a loaf of bread as that they are familiar with the ornamental features of our modern educational system. We recently heard one of the most intelligent ladies in New Hampshire say in discussing this question that she had daily reason to regret that her education failed to such an extent to instruct her in the duties of caring for a home and rearing a family of children.

In some States the agricultural college is in full accord with the interests of the farmers, placing the agricultural departments of the institution in a prominent position, and by special effort having secured a goodly number of students for this department. On the other hand, it is claimed that in some States the agricultural feature of the college is but little more than a burlesque, existing in name to obtain the influence of farmers in securing appropriations from State Legislatures to educate men and women into other avocations and professions. Under such conditions the number of students in the agricultural courses is of necessity small, and this fact is cited in evidence of the assertion that there is little demand for such instruction.

We do not take the position that the industrial colleges should teach nothing but agriculture, for we recognize the importance and value of instruction in other industrial pursuits; but we do take the position that aid to agriculture should not be used simply as an excuse for securing the appropriations that establish and support these institutions.

We assert that agriculture has suffered in the past by the withdrawal of some of its ablest followers to engage in other occupations and professions, and that the agricultural colleges can do patriotic work by causing students to be surrounded by an atmosphere impregnated with agricultural spirit and agricultural loyalty.

We believe it should be our aim, wherever appropriations are asked for by these institutions, and whenever policies are being established through the appointment of college officials or the adoption of regulations, to see to it that agriculture is kept at the front, and that the training of students to become practical farmers or instructors in agriculture be not relegated to the rear. Such effort as this is of the most patriotic nature, and contributes to the welfare of the people in general: for whatever promotes more intelligent cultivation of the soil promotes greater prosperity among all the people. The spirit of commercialism has permeated the leaders in every industry and profession, and in some instances made money-making a greater incentive to activity than the promotion of principles that are important. This tendency has been recognized by educational institutions of all kinds, and prominence given to those departments that fit people for making the greatest amount of money for themselves, and sometimes to the neglect of those departments that fit people for promoting great fundamental industries. It is important to see that not merely farmers, but the great cause of agriculture, does not suffer by the trend of the industrial colleges away from this industry which they were primarily established to promote, and chiefly in the interest of which they are supposed to be maintained.

Agriculture in Public Schools.

The introduction of agricultural studies in public schools will have far-reaching effect in the development of agricultural sentiment and in popularizing the agricultural industry. All true reform movements begin with the people, and but little progress will be made in this matter until the people demand it. It is becoming recognized by educational experts, in response to this demand, that mental development can be obtained as effectively through the study of such sub-

jects as afford information to the student as through the study of such matters as only afford mental discipline. Mental development will result from the study of plants and trees that one comes in contact with every day, and the processes of nature by which the elements of the atmosphere and the elements of the soil are combined to produce those plants and trees, as well as from committing to memory the height of the principal peaks of the Rocky Mountains or the names of the rivers of Hindoostan. It is admitted that a boy or girl will be educated while studying the nature and composition of the rocks which are passed every day, or the names and habits of the birds that constantly fly over their heads, as well as by the study of the dead languages or the almost meaningless problems of higher mathematics. Life will seem broader and deeper and happier, whatever the occupation or profession followed, by reason of knowing something about the plants, trees, rocks, birds and soils with which one is constantly coming in contact, than it would seem if ignorant of these matters, although able to do some of the things once considered necessary for an education. This is an important function of nature studies and of the more intensive course known as principles of agriculture. Instruction in this matter is now included in the normal school training in some of the States, and introduced in the public schools of those States. We do not contemplate in this matter teaching how to grow corn or fruit, but to impart information upon the operations of nature that cause corn and fruit to grow, and the underlying principles which cause a combination of the elements of the atmosphere and of the soil to combine in producing the magnificent forests and bountiful crops.

Highway Improvement.

It would be ridiculous for a person to come to Massachusetts and advocate the advantages of good roads in securing rural betterment, for of all the States Massachusetts stands at the head in liberal expenditure of money on highways. There is no valid reason why the public roads of every State should not be improved in the same ratio as the houses in which the people live, the carriages in which they ride, the buildings in which they educate their children and

the churches in which they worship. In many sections of the country the purse strings of individuals have been loosened easier for comforts and luxuries than the purse strings of public treasuries for the improvement of roads. We recognize the leadership shown by Massachusetts in greater equality in this matter.

The phase of road improvement that I desire to emphasize is through national aid to road construction, with the hope of arousing the farmers to active efforts to secure it. The farmers have been loyal to the interests of the nation in every emergency in the past. They have contributed their full share in proportion to their wealth to the revenues for the support of the government. The ablest statesmen and most successful business men contributing to the development and prosperity of the country point to the farms as their birthplace, and we refer to them as the farmers' contribution to State and nation. When our country has been in danger from internal dissensions or external foes, resulting in bloodshed, the farmers' boys have responded nobly in her defence, and many of them never returned to homes that mourn their loss. We have uncomplainingly contributed our share to the enormous expenditures of the national government for river and harbor improvements, the construction of canals and the erection of costly buildings in our great cities, and we do not regret it. We now ask, in the name of justice and equity, that national aid be granted for the improvement of highways. This involves the establishment of no new policy, but the extension of a former policy. We ask the loyal support of those who have been benefited by our contribution to other public matters to which I have referred. I believe I have authority to say that the farmers of the nation, representing more than a third of our population, are practically unanimous in favor of such a movement, and will give it their unqualified support.

The Parcel Post.

While all classes of people sending packages from one locality to another would be benefited by the establishment of a parcel post in the post-office department of the govern-

ment, the dwellers in rural sections would be specially benefited thereby. The parcel post is a logical sequence to rural mail delivery, and by this means the parcels mailed would be taken direct to the houses of the people upon rural delivery routes, which facilities do not exist in express company service. Rural mail carriers could collect and deliver several times the present amount of mail matter without material cost, and through the receipts from a parcel post system the annual deficiency arising from the rural delivery system might be reduced. The post-office department that has hitherto turned a cold shoulder toward the parcel post innovation now recommends a local parcel post over separate rural routes. This is not what the people ought to have, but might act as an opening wedge to something better. Some one has remarked that there are three great objections to the establishment of a general parcel post, namely, the Pacific Express Company, the Wells, Fargo Express Company and the American Express Company. It must be admitted that the influence of these companies for retaining a profitable business is tremendous; but the profits of a few thousand stockholders in these companies should not stand in the way of the legitimate privileges of 80,000,000 people. The difference to millions of people between sending a package by express for 25 cents and by parcel post for 6 or 8 cents, and in the latter case to the door of rural consignees, is an argument that should be given attention by those in authority in the matter.

We understand that all the leading countries of Europe have the parcel post. In Germany the rates for distances up to 46 miles are: 11 pounds, 6 cents; 22 pounds, 12 cents; 33 pounds, 18 cents; 44 pounds, 24 cents; 110 pounds, 60 cents. In all Germany, including Austria, 11 pounds are carried for 12 cents. In Switzerland, up to 62 miles, 110 pounds are carried for 60 cents. The general rates are: 1 pound, 3 cents; 5 pounds, 5 cents; 11 pounds, 8 cents; 22 pounds, 17 cents; 33 pounds, 23 cents; 44 pounds, 33 cents. The rates in other countries vary somewhat, but are not substantially different. In Great Britain, or the United Kingdom, the rates are: 1 pound or less, 6 cents;

2 pounds, 8 cents; 3 pounds, 10 cents; 4 pounds, 12 cents; 5 pounds, 14 cents; 6 pounds, 16 cents; 7 pounds, 18 cents; 8 pounds, 20 cents; 9 pounds, 22 cents; 10 pounds, 24 cents. In Italy, 6½ pounds are carried for 12 cents and 11 pounds for 20 cents. In Hungary an 11-pound package is carried up to 10 miles for 7 cents, and to any point in the kingdom for 15 cents. In 22 countries that have the parcel post the weight limit is 11 pounds. Congressman Henry of Connecticut introduced a bill at the last session of Congress, which will be reintroduced at the next session, providing for the establishment of a parcel post, with rates under 3 ounces in weight, 1 cent; 3 to 6 ounces, 2 cents; 6 to 9 ounces, 3 cents; 9 to 12 ounces, 4 cents; 12 to 16 ounces, 5 cents; and 2 cents for each additional pound or fraction of a pound, making the limit 11 pounds for 25 cents. The farmers of the country should be heard in favor of this or other similar measure in the interest of rural betterment.

Organization.

The important matter in this discussion is the means of securing these advantages for rural communities. More progressive and up-to-date agriculture may be promoted through the active efforts of boards of agriculture, dairy and horticultural societies and agricultural fairs, and a liberal policy on the part of the State in support of these organizations. The summer business may be materially extended by liberal and judicious advertising. The other matters to which we have referred can only be secured by the co-operation of farmers through organization. It is the method adopted by those engaged in other industries and the professions. This does not imply that farmers should resort to action of an antagonistic nature towards any other industry, or institute boycots and strikes in their own. It implies that the farmers should depend more upon co-operative effort among themselves in securing just recognition in schools, colleges, State Legislatures and Congress, and less upon what the other fellows are voluntarily inclined to give them. It implies organization for constructive objects, rather than destructive purposes. It may be through organizations for

each specific object, or it may be through that great national organization, the grange, which champions the farmers' interests in every worthy direction. After an existence of nearly forty years, it stands unrivalled in the country as a representative of the agricultural interests and the farmers' welfare. It combines social enjoyment, mental development, and through co-operation the means of awakening public sentiment in favor of legitimate legislation, that cannot be obstructed by combined wealth or the subterfuges of wily schemers. It is the farmer's improved machine for planting, cultivating and harvesting his crop, which is the most important of all, noble manhood and helpful womanhood, and the opportunity to secure for themselves through fair conditions a rightful share of the rewards for honest toil, to the end that the activity in rural communities may regain its early standing and agriculture return to its rightful place at the head of all the industries of New England, and her followers the true noblemen of the land.

PUBLIC WINTER MEETING

OF THE

BOARD OF AGRICULTURE,

AT

WORCESTER.

DECEMBER 5, 6 AND 7, 1905.

PUBLIC WINTER MEETING OF THE BOARD, AT WORCESTER.

The annual public winter meeting of the State Board of Agriculture was held at Horticultural Hall, Worcester, on Tuesday, Wednesday and Thursday, December 5, 6 and 7. The weather was unusually favorable, being generally clear and moderately cool.

The meeting was called to order at 10 A.M., by Secretary Ellsworth, who introduced First Vice-President William R. Sessions as the presiding officer for the morning session.

Prayer was offered by Rev. A. W. Hitchcock of Central Church, Worcester.

The CHAIR. We meet in the beautiful and enterprising city of Worcester through the invitation of its people, in connection with various societies here, and the mayor is present to welcome us in behalf of the city. We will listen to him.

ADDRESS OF WELCOME, BY HIS HONOR WALTER H. BLODGET.

Mr. President and gentlemen : Among the pleasures which come to the mayor of a city, and which are mixed up with the many troubles that we have, is the pleasure of welcoming delegations from other places to our city. And especially is this a pleasure for me this morning to come here and welcome a gathering of agricultural people to our manufacturing city. You have come, gentlemen, to one of the largest and best manufacturing cities in this country. I suppose that we have a greater variety of manufacturing industries in Worcester than in nearly any other city in this country ; and I also suppose that we have more skilled master mechanics, for the size of our city, than any other city in this country.

So you will see that you have come to one of the best manufacturing cities there is, and it is certainly a pleasure for me to stand here and welcome you.

Worcester is situated in this lovely valley, surrounded by hills. We not only are a great manufacturing city, but we also claim to be a large agricultural town; for it only takes ten or fifteen minutes to go from our busy city out into the country, and there we find the splendid farms which surround our city. Thus we who live here in Worcester not only have the privilege and the pleasure of living in one of the best manufacturing cities in the country, but we also have the pleasure of almost being farmers also.

We can enjoy your farms with you, and some of us have the pleasure of owning little farms ourselves. And it is certainly a great pleasure to live in a city which is not so large but what we can enjoy the country also. So you see that you have come to a city which has the combination of not only being a large manufacturing city but also being an agricultural town. I believe that Worcester has the reputation of being one of the good markets of this country. Of course we realize that our market is not large, but the requirements of our market are such that we must have good quality of goods, and such quality is always paid for. So that I say that Worcester is one of the best markets for your products that there is in the country. The farmers who surround our city are largely interested in truck-growing,— growing vegetables and small fruits for our local market; and I believe that farmers in the vicinity of Worcester are as well situated if not better than any growers in this great country of ours, for they have the benefit of having a market near home, and they have the benefit of many pleasures and comforts which are not accessible to farmers who live far distant from their markets. So I think that Worcester farmers are splendidly situated, and ought to be well satisfied with their surroundings.

Now, gentlemen, I am not going to make a long speech this morning. I am more than glad to have you come here. Worcester people are always glad to recognize the good qualities of all organizations which come to our city, and I

am sure that this meeting will not only be a help to you, but will also be a help to our city. I hope that it will be not only interesting but instructive, and that when you go from Worcester you will feel as though you had had a good meeting and a good time.

The CHAIR. We are privileged to meet in this beautiful hall; it has been extended to us by the society which owns it. The president of that society has been for many, many years interested in the agriculture of Massachusetts, as well as in its horticulture. He is here to-day, and we desire to hear a word from him, and he no doubt desires to say a word to us. We will hear from Mr. Hadwen.

ADDRESS OF WELCOME, BY HON. O. B. HADWEN, PRESIDENT WORCESTER COUNTY HORTICULTURAL SOCIETY.

Mr. President, ladies, and gentlemen of the Board of Agriculture: I have been asked to say a word, and in behalf of the Horticultural Society I will bid you a most cordial and hearty welcome to their building, which they tendered to the use of your Board during your visit in this section. The Board of Agriculture was first suggested in the Agricultural Club which now exists in Boston. It was organized in 1840. There were thirteen members at the time, one to represent each of the original States. Colonel Wilder, who was for a long time connected with this Board, was one of its early members. He and the gentlemen associated with him thought that the agriculture of the Commonwealth should be sustained, and that there would be no better way than to have a Board of Agriculture, the members to be selected from the several agricultural societies of the State, and also gentlemen who were well up in the science. So your Board was incorporated in 1852, and was one of the first that existed in this country.

You have had several secretaries. The first was Amasa Walker of North Brookfield, whom I recollect perfectly well. He was followed by Mr. Charles L. Flint, who occupied the position for twenty-seven years. He was suc-

ceeded by Mr. John E. Russell, a very accomplished secretary, and he was succeeded by Mr. William R. Sessions, who is now your vice-president. Mr. Sessions was succeeded by Mr. James W. Stockwell, and Mr. Stockwell was succeeded by the present Secretary of the Board, Mr. Ellsworth. Worcester County has furnished most of the secretaries of your Board. Mr. Flint married a Worcester County lady, so we shall have to count him in. During this long term of years Worcester County has furnished all but two of the secretaries.

It was my good fortune once to be a member of this Board. I think it was in 1872 that I was elected, and I remained until 1884. There are but two persons living that were on the Board at the time, and I notice but two persons present who were members when I was a member of the Board.

This Board has done a great work in forwarding agriculture throughout the Commonwealth, and not only this Commonwealth but many others have received a great benefit from the instructions that have emanated from this Board of Agriculture. In fact, Mr. Flint's reports were a perfect encyclopedia of agriculture, containing information of all the different pursuits that we had followed, and have been a great help to the farmers of the Commonwealth.

The Horticultural Society, of which you are now a guest, was organized in 1840, and this hall was erected in 1851. In the course of the year we have twenty-five exhibitions of fruits and flowers and vegetables, which have been a great help to this section and to the county and to the Commonwealth. During the winter we have ten meetings for lectures and discussions, which prove of vast benefit; and we also have one annual banquet, which brings the society together in a social way.

Colonel Wilder used to say that we were the second richest society in the world, and I think he told the truth. He used to come here and lecture to us and talk to us in a horticultural way, and we were always delighted. You all know very well that he was the Nestor of the Board of Agriculture, and remained with it as long as he lived.

I think that this society is doing perhaps as much work for the advancement of horticultural pursuits as any society in this country. The building that you are in is perhaps one of the most convenient horticultural buildings. Its location, standing as it does right in the heart of the city, easy of access by all the trolleys that are running out in all directions, gives it a central location; and it is used, I may say, almost every evening from October until May. The stores beneath are large and finely equipped; so the society is a prosperous one. It receives a large rental, which it uses for the encouragement of agriculture.

Gentlemen of the Board of Agriculture, to the hospitalities of this society we welcome you. May the purpose of your coming be accomplished in an out-going and in-coming ratio, and may you give us the words that shall come from a heart of well-developed experience, moving us to greater strivings after the fulfilment of our ideals. May you feel the invisible and unspoken blessings of the Heart of the Commonwealth, by which you are surrounded, moving you also to continue your striving after those things which seem to you to be higher and better.

The Chair. In connection with the city of Worcester and the Horticultural Society, the Worcester Agricultural Society invited us here. The gentleman who was president of the society when the invitation was issued is present, and we desire to hear a word of welcome from that society through Mr. Potter.

ADDRESS OF WELCOME BY BURTON W. POTTER, ESQ.

Mr. Chairman, ladies and gentlemen: In behalf of the Worcester Agricultural Society it gives me pleasure to say a word of welcome. I suppose it is a little unusual for you to have three addresses of welcome when you visit any place, but we simply wish to impress upon your minds that you are thrice welcome here to-day. Then you should remember, also, that Worcester speeches are always short. Three of them here are no longer than one would be in any other part

of the State. We are glad to have you come here at this time, when we have a farmer for mayor of the city to give you the city's greeting. We are also glad to have you come and hold this meeting in the home city of the secretary, in order that you may learn in what esteem he is held by his neighbors and fellow townsmen. And we are glad to have you come when Mr. Hadwen can welcome you as president of the Worcester Horticultural Society. Mr. Hadwen was on your Board more than thirty years ago, and as a resident member of the Board he welcomed you and called the meeting together in this hall twenty-nine years ago; and I have been in the city thirty-five years or more, and during all that time Mr. Hadwen's life has been an exemplary one in good citizenship and moral influence, and as an open book; and his influence has been important and beneficent, not only in these two societies, but in the community in which he lives, and I think you would stand by me if I should add in the State also. He is the Nestor and the Marshall P. Wilder of Worcester County.

We are also glad to have you come here to hold your discussions on real, practical agricultural matters. In fact, the farmers at the present time can go nowhere else except to these meetings and to the institutes for instruction and education in agriculture, — outside, of course, of the agricultural newspapers and the agricultural colleges. Our fairs are supposed to be educational in agricultural matters, but the management is always hampered with the idea that something must be done to make them pay; and about half of every committee of arrangements are in favor of shows and some sort of attractions that will amuse the people, so that the most of our fairs are half circus and half agricultural fairs. But in a meeting of this kind you are not hampered in that way. You are here to discuss practical agricultural matters. For instance, to-day you have up for discussion "Market gardening." Now, that is a very important industry in this Commonwealth. The changed condition of agriculture has brought the farmers to a large degree to raising truck or market gardening: and yet I believe that you have not had this matter open or discussed in one of your meetings for

seventeen or eighteen years, and the increase of this industry has been tremendous during that time.

To-morrow you are to have the dairy industry discussed, and I think it is safe to say that one-third of the agricultural productions of Massachusetts are the dairy products. It is a very important industry in this county, and it is very fortunate that you discovered a matter of that importance for discussion. Then, too, you are to have the fertility of the soil discussed, how to keep it fertile and how to keep it from becoming exhausted. And you are to discuss a campaign for rural improvement, which we are all interested in. And so I might go through the list. Every subject is important, and every subject is one which every farmer ought to be interested in; and therefore I say, on behalf of the Worcester Agricultural Society, we welcome your arrival, and when you depart we shall bid you God speed.

RESPONSE FOR THE BOARD OF AGRICULTURE, BY FIRST VICE-PRESIDENT WM. R. SESSIONS.

I see the secretary has upon the programme a reply to these addresses of welcome by the vice-president. It is too much of a task for me to follow in order the pleasant words which have been said to us here; but I want to assure these gentlemen, the city of Worcester, the two societies, that the Board of Agriculture appreciates Worcester, appreciates her agricultural society and her horticultural society, and the secretaries which Worcester County has given to the Board of Agriculture in the past. Worcester County is the banner county in the State, and has sometimes been almost the banner county in the country in the value of its agricultural products. It stands in the row of the first in agricultural production. Its farmers are as intelligent as the farmers in any county in the United States, as are the farmers in the city of Worcester; for while, as the mayor has truly said, it is a manufacturing city, there is, I think, only one municipality in the State of Massachusetts whose agricultural products are of greater value than those of the city of Worcester. As the mayor has well said, it is fortunately located over a large territory, so that its inhabitants who choose to follow

agriculture may do so, and still have the advantages that an enterprising city like Worcester bestows upon them.

Its horticultural society is known all over the State and all over the United States. Its presidents have been men of mark.

The agricultural society of Worcester is also one of the most noted in the country. It is one of the earliest organized in the country, and its past career has been such that its members may now point to it with pride. It is one of the very few that are endowed by an investment of their own acquiring.

But, gentlemen, you did not come here to hear me talk. I am very grateful, in the name of the Board of Agriculture, for the welcome which has been so eloquently and heartily given to us. But as you came for the purpose of hearing important agricultural questions discussed, and as the speakers are at hand, I will not take any more of your time, except to thank the city of Worcester and these societies again for their welcome.

As has been said by some of the speakers, the business of market gardening is one of the most important for this State and for this locality, and for the city of Worcester in particular; and the secretary and the committee which aids him in making out the programme have arranged for the first subject a lecture on market gardening, by a practical market gardener, — a man who, we are proud to say, pursued the study of the calling at our Agricultural College, and has since practised what he was taught there and what he has since acquired by experience and by reading. I now have the pleasure of introducing to you Mr. Henry M. Howard, who will speak to you on the subject of market gardening.

MARKET GARDENING.

BY MR. HENRY M. HOWARD, WEST NEWTON.

Producing several varieties of vegetables in large quantities is called market gardening.

It is a business carried on chiefly near large cities or towns in which the stuff can be sold. According to the last United States census, Middlesex and Essex counties produced $1,875,000 worth of vegetables in 1899, while the rest of the State produced only $1,325,000 worth, or about two-thirds as much. The above figures do not include potato and onion values.

Truck farming is carried on in any section of the country where the soil and climate are suited to the production of any one vegetable. Railroads and steamboats have to be used to bring this stuff to market, and most of it must be sold through commission men.

With market gardening a greater variety of vegetables is raised, and they are sold from the farmers' wagons to the dealers. The cost per acre for manure and labor is greatest on a market-garden farm, the last United States census giving the cost of labor as $340 and manure as $76 per acre for Massachusetts market-garden farms.

The most important essentials for market gardening are land, labor, manure and a large market.

The land used is that most convenient to the market, and is not always first class; yet by liberal use of manure, water and labor it is made to produce large crops.

Those farmers having a light, sandy soil are usually the first in the market with early vegetables. This kind of soil is suited for growing very early peas, beans, lettuce, spinach, radishes, corn and tomatoes; and again in the late fall

the light soils can be depended on to grow stuff as well if not better than the loamy soil.

Farmers having loamy soils do not have to use so much manure and water. Their crops come a little later than on sand, and are usually a little better in quality. During midsummer farmers having heavy loams are the ones who bring in the best stuff. I have never yet found a farmer among market gardeners who does not imagine that the other farmer with a different soil has a little better opportunity because of a better soil.

Those farms located nearest to the market are often the most desirable. The expense for transportation of manure and vegetables is very much less than on a more distant farm. Labor can be more easily obtained, and advantage taken of fluctuations in the market.

A load of 57 barrels of cabbage has been taken with one horse from Revere to Boston, a distance of about 4 miles. A one-horse load from East Watertown, about 4 miles out, has had on it 214 bushels of spinach. No such loads could be hauled a much longer distance with one horse. A single load from 10 miles out would be about one-half as much as that put on from farms 4 miles out.

The nearer the farm is to the market, the smaller we are apt to find it in area, and the more intensive its style of business, with a large proportion of its area under glass.

One of the smallest places is one in Methuen, Mass., where there are only 1½ acres, but from which the gardener, with the aid of two men, sells nearly $2,500 worth of vegetables a year.

A small farm of 3½ acres in Belmont has produced far greater results. This place is mostly covered with greenhouses. This farmer is an expert grower of lettuce, cucumbers, radishes, water cress, parsley and tomatoes. According to his own statement, he has made $40,000 profit in ten years. There is another farm in Belmont about the same size as this one, which has as much glass on it; and this farmer has been even more successful than his neighbor before spoken of. These two little farms are only 4 miles from Boston, and the salesmen are in the market every day,

thus keeping posted. They have the stuff every day, and so can dispose of it to advantage when short or when plentiful. These two men have been very shrewd business men, as well as good growers. They have had very little No. 2 stuff. They have worked with their men, and consulted them as to methods of doing the work. They have kept strict account of their business. No man knows better what to do than the one who is on the spot or doing the work. Often the workmen will discover some way of doing which is more economical in time, or makes the goods look better when exposed for sale; and this new way will be adopted. The amount of manure used on these small places will average 30 cords per acre. On a market garden of 25 to 35 acres it will average 18 to 20 cords, but on those of 75 to 100 acres you will find a different style of business, and the farmer using scarcely 15 cords per acre.

All market gardeners use horse manure in preference to any other, as it is the kind which makes the vegetables grow best. It is usually broadcasted and plowed in not over 6 inches deep.

Manure is the principal source of plant food; but on most market-garden farms at some time during the growing season you will find the farmer using nitrate of soda, sulphate of ammonia or fertilizer, to make some crop grow faster.

Nitrate of soda is very quick in acting, its effects being seen in three days. Great care must be used in applying it, so as not to injure the crop. There are two times when it is safe to apply it, — they are when the crop is dry or when a hard rain is falling. It should be applied about 80 pounds per acre at a time, and not again for about ten days. If applied too heavily, there will be loss by leaching and it may burn the crop. Sulphate of ammonia is slower in acting, and can be used in larger applications at one time without danger of waste by leaching. It is equally liable to burn the crop.

The manure supply for these market gardens is hauled quite regularly. Some of the large stables have to be cleaned out every day. Wagons holding 2 cords or over and drawn by three or four horses are used to carry it in.

Two men are usually sent on the wagon, and they make two trips a day.

When the manure is piled on the farm, it is in some spot convenient to the cultivated land. Onto these piles of fresh manure is thrown all the waste from the wash-house. The best way to build the pile is to make a bottom as large as desired and keep the top levelled as each load is added. Piles built in this way and tramped hard will not burn much. Some market gardeners use a lot of water on manure when overhauling in the summer for fall use. In February and March all the manure is overhauled once or twice, usually twice, and made ready to use.

We find some market gardeners about Boston who have a clayey soil plowing in about 10 cords of strawy manure in the fall, and as much more in the spring. By so doing they can get very good crops. Where the land is heavy or late, and the crops planted on it are celery, onions or parsnips, it is advisable to manure in the fall.

Some interesting experiments have been tried with manure on market gardens, and some of them have been very costly. There is probably not a market gardener present who has not at some time injured a crop with too much manure, or more often some of his crops have suffered for lack of manure or proper application.

Manure which has had well-fed hogs on it will be found highly beneficial to early spring spinach, but it is very injurious to the small red radish. Manure which is too rotten is dangerous stuff to use in large quantities for lettuce. It is much safer to use fresh manure for lettuce; in fact, it will grow the best lettuce. In the open field or hotbed I have found nitrate of soda great for lettuce. Cow manure is first class for corn, spinach and beets. We used one year something like 600 cords of manure from the cattle yards in Watertown, and found it especially good for spinach and beets.

The help on most of our market gardens is largely Italian. It is good help, intelligent, quick to catch on and very industrious. It is easy to get help on any farm near Boston where the carfare by trolley is only five cents, but beyond that limit it is much harder to get it.

The men for foremen are mostly young men who have grown to manhood on the place, and have become expert in a good many lines, as putting in seed, setting plants or putting up stuff for market. These men get $25 to $35 a month and board; the Italian men get $9 a week; women and boys get $1 or less per day.

The number of hands employed in the busy season is a pretty good index of the amount of business done. On one place of 7 acres I have counted 20 hands; on one of 10 acres, 27 hands; and one of 100 acres, 120 hands. On another place of 80 acres only 60 are employed during the busy season.

The cost of labor on some of these places will be as high as $400 per acre for a year; on others it will not be over $250.

Two of the most important men on a market garden are the plowman and salesman. Without the plowman you cannot plant, and unless the stuff is well sold there will not be much profit.

A good plowman usually takes great pride in his work, and for fancy work he has his favorite horse. As I have watched these plowmen of different farms, it has seemed to me that a level-headed horse is a great aid to the plowman in doing good work. A good plowman can do most of the hilling of potatoes, corn, celery or tomatoes, and in the harvesting of celery or parsnips he can help immensely by the proper use of his plow.

The market gardener gives very careful attention to the preparation of his ground for a crop. It must be plowed and dragged level. Next it will be manured. In manuring out, great care is taken to have the piles even in size and equally distant apart. When they are spread every inch of surface must be covered evenly to the edge of the field. Then the manure is plowed in not over 6 inches deep, and the surface dragged level again. Now the plot is ready for plowing and raking. The plowman begins his work, and 6 men with iron or wooden rakes follow him and rake down each furrow as it is turned up, smoothing out the whole surface, and raking all stones or rubbish into the furrow. This method of preparing the ground is practised on all market gardens about Boston when a fine seed bed is wanted.

The man with the seed-sower begins to sow as soon as there is opportunity, and tries to keep close to the rakers, so that the seed may be covered with moist soil. This is a very important matter, and must be attended to if a good "come-up" is wanted. In sowing seed market gardeners use an immense amount at each seeding, often using two or three times the amount recommended by seed catalogues.

The cultivation of closely planted crops is chiefly by use of slide hoes and weeders. The crops are gone over very often, say once in five to ten days. It is no mistake to go over them often when young. The cultivation aerates the soil, preserves the soil moisture, kills the weeds and makes the crop grow.

Market gardeners will not cultivate a crop when it is wet, or when the soil is so wet as to make clods.

On market gardens you will find crops of peas, beans, cabbage, corn, tomatoes and summer squash, hilled or ridged up to with the plow and finished off with the hoe. The ridge makes a fine warm feeding ground, and the frequent cultivation and hoeing hastens the maturity of the crop. Some farmers will argue for level culture, and under certain conditions it will be the best culture: but I have yet to find a market gardener who will practise it. He is satisfied that his crop will mature earlier if hilled up.

Many crops have to be thinned so that they may grow to perfection. This thinning must be done before the plants get too large or too soft, or run up. No crop raised on a market garden needs more careful attention to thinning than lettuce. It must be thinned while young, and only one plant left in a place, say every 10 or 12 inches, if the best heads are to be obtained. The cultivation of most crops continues till they shade the ground or begin to mature.

The area in glass is increasing every year. Any one who succeeds well with greenhouses usually builds more of them. It takes some time to learn the greenhouse business, and some men seem never to learn it. One grower whom I know had his houses three years before he made much profit from them. Another grower has 10 large houses, given chiefly to raising lettuce, but he has no skill in running greenhouses. He has

quite a reputation for poor lettuce. This same grower is very successful with hotbed lettuce and all out-door vegetables.

Lettuce is the most profitable of any crop grown by market gardeners in greenhouses. Some of the best growers have taken crops of lettuce in four to six weeks from the time of setting the plants: many growers are eight to ten weeks in getting a crop.

Most greenhouse men like to tell of the high prices for stuff, but they seldom tell of the low ones. During the winter of 1904–05 there was a period of seven weeks in which lettuce was bought by one of the largest produce firms in Boston at from 25 cents to 75 cents a box of three dozen heads. So far this winter the price has ruled low.

Unless a grower can get a high average price, or strike the market high once in a while, there is not much money for him in the business; but he who has enough stuff to be in the market every day is sure to strike it right some time.

A great many hotbed sash are used on market gardens for raising plants to set in the open, and for lettuce, dandelions and cucumbers to mature. On some farms we find 2,000 or more, but on most of them about 300 to 500.

Where hotbeds are to be used early in the season, the planks are set in the fall and filled with leaves or manure or both, to keep frost out. The upper plank should be 3 inches higher than the lower one. The loam in a newly made bed should not be nearer than 3 inches to the glass.

Several of our largest market gardeners have made use of large quantities of water for irrigation. It has been productive of great results, increasing the gross and net returns per acre, and making possible a quicker rotation of crops. Almost any crop can be benefited by use of water. Corn, tomatoes, celery, lettuce, cucumbers and cabbage seem to show its effect most quickly. There is great danger of not beginning to water soon enough, and nearly as much of not using enough. Too little is worse than none; it beats the surface, and promotes a greater evaporation of the subsoil moisture. The soil must be thoroughly wet, and then the surface stirred as soon as it can be, to preserve the moisture.

A steam pump which will lift 2 gallons at a stroke and run 75 to 100 strokes a minute will give about 120,000 gallons in a day, and will cost about $5 a day for coal and labor. Money invested in an irrigation plant is well invested; it is the next best investment to manure for a market garden.

The chief obstacles to good work at market gardening are conditions of weather which prevent the most careful growers from getting first-class stuff.

There may come a late or early frost, to pinch some crop. It may be so hot and dry that lettuce will run to seed, and much other stuff be spoiled before it is mature. A hail storm may come when you have a crop of lettuce or spinach ready to sell, and fix it in a few minutes so that you never can sell it. Blight, rust or rot may strike some crop which the market gardener is raising. But with good care and cultivation he need never fear that he will lose all of his crops. The blighting of celery and tomatoes seems to be increasing in late years. The yellowing of fall spinach and late lettuce makes the raising of a good crop of either impossible in some localities.

Some of the Good Things about the Business.

The market gardener sells his goods for cash. This simplifies his accounts immensely. In a large market he can sell all grades of goods, and this encourages him to grade his stuff carefully.

There is much variety to each day's work. Help can make longer hours of hard work than they could at some other kinds of business.

Crops mature in a short time. There is great opportunity for good management, and most market gardeners delight in harvesting one crop from a field and getting another started on the same place the same day. There is so much variety to the crops that if one fails there is still time to try another.

Most of the waste corn fodder, pea and bean vines and beet tops can be sold to milkmen. Then all the ground between rows of corn, celery and tomatoes can be used for growing smaller stuff, like spinach, lettuce or radishes, with-

out hurting either; and in this way large gross returns can be made for each acre. On one large market garden where this system of close planting has been in use for years they raised and sold, in 1904, 14,000 boxes of radishes which were grown between rows of other larger crops. On one day they had 612 boxes, which brought $165.

The amount of business done per acre on market gardens varies from $400 to $1,000 or over. While there are many market gardeners who can give you the returns from each crop raised, there are very few who have gone into cost accounting, and can tell how much any crop has cost.

It is no uncommon thing to see some of our largest market gardeners bring in 1,000 to 1,500 bushels of stuff in a day. Some man will bring in 1,000 bushels of spinach, or 500 to 1,000 dozen of lettuce, or 400 to 600 boxes of radishes, or possibly 200 boxes of tomatoes, beans or sweet corn.

The sales from some of these gardens will run over $1,000 for a single day; but there are many days without sales, or prices may run very low. Some of the low prices the past year have been: for spinach, 4 cents; lettuce, 5 cents; parsley, 5 cents; radish, 15 cents; corn, 25 cents; beans, 25 cents a box; cabbage, 40 cents a barrel; and squash, 65 cents.

The market gardeners within 4 to 6 miles of Boston will continue to grow large quantities of cheap stuff so long as the market will use it. A farmer much farther out would find it nearly impossible, with ordinary means of transportation, to deliver 1,000 boxes of stuff in a day, even if he could get the help needed to raise and harvest it.

It takes a first-class man to sell so much material in a day. He must be well posted on the supply and demand for his kind of stuff, and make his prices right in order to dispose of his perishable product while it is fit to sell. Sometimes the market price will go up fast and stuff go out short, and it takes a smart man to see the change and profit by it. When prices are low and the market glutted, a good salesman is especially needed. Unless the market gardener is a good salesman himself or employs one, he will not get the profits which ought to be his for running the business.

The market gardener who takes the best advantage of the market and the weather in the management of his business will be found the man making the most money from it.

The CHAIR. You have heard an excellent lecture, full of chunks of wisdom, — admirably so. I hope you will take advantage of the opportunity to question the lecturer. The discussion, as has been stated by some one, is sometimes of more importance than the lecture, and I hope you will improve your opportunity.

Mr. GEO. T. POWELL (of New York). What is the general cost of manure a cord, delivered at the grounds of the market gardener, including the cost of hauling?

Mr. HOWARD. I believe the farmers figure that the cost of manure delivered on the farm is about $4 per cord. From my own experience, — and I have kept actual record, — the cost of my manure, delivered on the farm, last year was $2.15 per cord. That included the first cost and the cost of hauling. My hauls are very short. I don't have to go over ten minutes when the team is empty, and about twenty or twenty-five when loaded, which makes the cost of hauling very small. Where a man has to haul the manure 5 to 7 miles, and sends four horses and two men, it is rather expensive.

Mr. H. R. KINNEY (of Worcester). I have been very much interested in the address this morning, and I judge, from what the secretary has told us, that the lecturer spoke from experience. If he can make the people here in Worcester see how they can make as much money as the people around Boston, I wish he would. That is what would be very interesting to me about this time, and I guess to some others also. Worcester, I think, is getting to be a city that requires, as the lecturer says about Boston, a great quantity of poor stuff. Every year it seems to me our market discriminates less between good and poor than formerly. Of course there is some good trade, but there seems to be less demand for high-grade products than for lower ones. I don't know but it is caused by the gardeners raising and handling stuff as cheaply as they do. Spinach is put up in

a careless way, and has to be sold at 8 or 10 cents a bushel, — no care given to the harvesting or the putting up. And other things are done in the same manner. I can remember when there was a demand in Worcester for a good article, and a fair price paid for it, but I believe that time has gone.

Mr. Howard. The gentleman who spoke last seems to think that when stuff is the cheapest it is the poorest, but it is the very opposite. When spinach is plenty, the housewife doesn't have to pick it over at all. The farmers pull it up; it is never washed. One man can harvest 24 or 25 bushels an hour, and can land that spinach in Boston from 10 miles out at 4 cents a bushel. If they can get 8 and 10 cents for it they are making money, and are glad to do it. The people profit by it, and get their spinach cheap. And when lettuce is the cheapest it usually is the best. It is so with most of our vegetables, and it is a very good thing that it is so. It stimulates people to buy more, and they get into the habit of using the vegetables, and once forming the habit, they keep right on. Then if the price goes up, they don't mind, — they have got to have it. It is a mighty good thing we can produce them cheap.

Mr. P. M. Harwood (of Barre). I am not a market gardener, but I have been a good deal interested in this address, which has been so ably given, and I have noticed some things about it. It was full of meat. Now, evidently Brother Howard is not a florist; there was nothing flowery about this address, — it was full of the necessities of life. I feel almost like throwing him a few bouquets to help him out. But I arose for the purpose of calling the attention of this audience to the fact that they have before them the greatest opportunity, I believe, that they ever had, and perhaps as good an opportunity as they will have for some years to come, to learn something. Now, this gentleman knows what he is about. I have followed him for some years. Brother Howard wrote that address to go into the report, and if you want to wake him up, just fire questions at him. You will find that you will get all you ask for. It is there. I remember once asking one of the leading market gardeners, in private conversation, to what he attributed his success,

and he said, "To my ability to leave my business behind when I cross the threshold of my home." Now, if I ask Brother Howard to what he attributes his success, I don't believe that, though good, will be his answer, but he will have one.

Mr. Howard. I attribute my success — as much as it has been — to keeping everlastingly at it.

Mr. E. L. Ripley (of Hingham). Did I understand the lecturer to say that his manure only cost him $2.15 delivered? He recommended for market gardening good stable manure. Now, does he get good stable manure landed on his farm for $2.15 a cord? If he does, he has an advantage over most of us, I think. I think I must be mistaken in the way I understood him.

Mr. Howard. That was my statement, — $2.15 per cord, landed on my place. I make the contracts for that manure, — nobody else makes them. And I superintend the men who haul it, and they put on a load, and they have broken down two wagons for me trying to get load enough on. I have got a third one, and have braced it up, and I think it will hold it.

Mr. E. Moore (of Worcester). Do you think it possible for a man located a little farther back than you are to compete successfully by the use of commercial fertilizer in connection with market gardening?

Mr. Howard. A great many crops seem to be a great deal better where there is not too much manure put on the ground. One of those crops, which is especially so, is that of cauliflower. The highest-priced cauliflower coming to Boston comes from lands which are manured with commercial fertilizer. The cost of applying commercial fertilizer is very small compared with the cost of applying manure. Have I answered your question?

Mr. Moore. Yes; partly. I want to know if in your experience you know of those who are practising that method of using commercial fertilizer on account of their situation in regard to the market? There are not many who can get manure for $2.15, or $4.15, a cord; and if they come in competition with you, they must naturally get it

at a cheaper rate. Do you know cases where it is being done, say 60 miles from a market?

Mr. HOWARD. I think I see a man in the audience who is pretty well posted on the use of commercial fertilizers, — Mr. Wheeler of Concord. I think he can answer your question very satisfactorily.

Mr. FRANK WHEELER (of Concord). We are situated on the border line, and, not being able to get manure cheaply enough, are obliged to use fertilizer, therefore they both come in. I couldn't get along without either one. Perhaps I spend more money for fertilizer than I do for manure. We are not, perhaps, quite in the market-gardening business as Mr. Howard is, not quite so fine, but we produce the coarser products; not quite so perishable as lettuce and spinach, — more like sweet corn and cauliflower, and that class of products. We have to use both manure and fertilizer. Our manure costs in the neighborhood of $4 to $5 a cord, — nearer $5 than $4, on the average. It costs us $3 a cord on the cars at Boston, and from $0.75 to $1.25 for freight, and then we have to haul it from 2 to 3 miles, so that we can't see our way out of it, — unless we buy 20 or 30 or 40 cords a year. We use from 5 to 15 cords per acre, and make up the balance with fertilizer. We can make a living, and that is about all.

Mr. POWELL. I would like to ask Mr. Howard whether on cheaper land, say out 10 or 15 miles from the Boston markets, there could not be an advantage in using lime part of the time and growing clover and cow beans, and plants of that character, plowing them in, and using commercial fertilizer with those? Do not these plants practically furnish to the soil what stable manure would furnish, and at very much less cost? I realize that in your situation at Newton, and places of that character, land is too high, too costly, to devote to the growing of green crops, because time is too valuable; but could not leguminous plants, such as clover and cow beans, be used where the land is more plentiful, together with commercial fertilizer, at very much less cost than buying from the cities stable manure?

Mr. HOWARD. It is my opinion that it could be done,

and should be done, where a farm is located 10 or 15 miles back from the market, and where the land is much cheaper. But land within 5 or 8 miles of Boston will rent from $100 to perhaps $15 per acre; I know of some cases where the rent will run as low as $15 per acre. The greatest possible amount of nitrogen which can be furnished, — I wouldn't say nitrogen alone, — mineral elements furnished by a green crop to be plowed in, was stated in this hall at one time to be $42. I studied that matter over, and thought that I could not afford to devote for one year the use of an acre of land, from which I might make a profit of $250, to save $42. But at a distance farther back from the market the method of rotation should certainly be practised, and a man is not "onto his job" who doesn't practise it.

Mr. Harwood. I have watched Mr. Howard, and I am satisfied that one element in his success is his system of accounts. In his address he spoke of the fact that very few market gardeners keep accurate accounts. Now, if Mr. Howard will kindly lay aside his modesty just for a moment, and speak about himself, especially as far as relates to the keeping of accounts, I think it will be highly interesting and profitable to the audience.

Mr. Howard. This system of accounts which I discovered or invented is a simple system. Each man on the place has a name, and his name is written on the book; a page is given to the day's labor, whatever that may be. Different columns are headed, for instance, "Sales." A man who spends his time on sales is charged under that column with the cost of his labor, — for the hours that he is busy selling. He returns from the market, and puts up lettuce; under the column headed "Lettuce" he is charged with the expense of putting up that lettuce. His time is all set down in hours. The bookkeeper figures up each man's time according to his rate of wages, which is variable, and that amount is posted to the ledger account; so that each day's account shows the cost of selling, the cost of lettuce, the cost of spinach, the cost of radishes, celery, cabbage, cauliflower, improvements, manure; anything that I have done about the house is charged to the house; expense account, repairing harnesses,

wagons; fall work is charged up under the head of "Fall Work." Each day's account is thus posted, and at the end of the month it is footed. I know what it has cost me to weed my strawberry bed; it cost, the last time, $15.22 to weed it. I know what it cost me to set my greenhouse boiler. There is no guess-work about it. I do my guessing every day and set it right down, and the bookkeeper foots it up. And every man who is doing much business cannot afford to do without a bookkeeper. I heard one man say that he wouldn't have one, because the bookkeeper made mistakes. They are liable to; so are we. But two of us working together might correct a mistake that had been made, and we would get nearer to the right. I set about this business of keeping farm accounts so that I might know which crops were the most profitable. If I put $1 into a crop, and get 90 cents back, there must be some reason. If I put $1 in, and get $6 back, there must be some reason. And I am working for $6 crops, where I can put $1 in and get $6 back, or more. This is on the labor account. The manure and the water are charged up as a gross sum to the land. I cultivate 10 acres now; I cultivated 50, but I prefer 10 in a close and intensive culture to 50, and I think it is really a better business.

Question. What is the effect on the laborer?

Mr. Howard. It stimulates the laborer. The laborer knows that the bookkeeper will take account of what he accomplishes. If a man puts up only 50 bushels of spinach in an afternoon, washes it through the tub and puts it up, he is liable to get something of a stimulation, because he ought to put up about 30 an hour. And if he can only wash 10 boxes of lettuce in an hour, he is considered no good; he should put up at least 15 an hour.

Question. What about the horses?

Mr. Howard. The time of each horse is charged, so that I know how many hours' time and how much value in time the horses spend on each crop. The time of the horse in selling is charged, and I find that my horses — I keep four — average only a little over five hours a day, and they are hard worked. They average only a little over five hours a

day for the year, but sometimes in the year they have worked a good many hours. A horse may make two trips to Boston, and the distance is 9 miles; but another day he may stand in the barn pretty nearly all the time, — be out one hour, perhaps.

QUESTION. Do you pay your laborers by the day?

Mr. HOWARD. I pay the laborers by the day, or week, or month.

QUESTION. Do you have a system of so many hours a day?

Mr. HOWARD. Yes: some put in about ten and one-half hours a day; they start at half-past 6 in the morning, with an hour at noon, and work till 6 at night.

QUESTION. Can you do that through the months of November and December?

Mr. HOWARD. During November they start at half-past 12 at noon and work until half-past 5, and are liable to work till 6, but not intentionally: and during December there are fewer men, and we get through about 5 o'clock.

Mr. N. B. DOUGLAS (of Sherborn). I have been very much interested and instructed by the paper read this morning and the discussion which has since followed. I believe our brother has struck the keynote of success in farming, not only in market gardening but in general farming, — the idea of knowing what a thing costs; knowing what you are doing; keeping accounts. I believe that it would be thousands of dollars in the pockets of our Massachusetts farmers every year if every one of them knew what they were doing with their dairies, — if they knew which kind paid and which kind did not. It does not pay to keep a cow a year, and get $25 or $30, possibly, or even $40, in return, if it costs $54 to keep her. We should know what she costs to keep, and what she pays. I followed dairying over fifty years, and during all that time I didn't know; but, thank God, I have got on the other side now, and keep an account, and when I find a cow is living on me, she goes out and lives on the other fellow, if she lives at all. And I believe that is a step in the right direction.

Mr. POWELL. I have asked a number of questions of the

speaker. but I want to express my very high appreciation of the paper as a whole. I do believe that in this presentation of the market-gardening business as conducted by Mr. Howard, in his advocacy of keeping accounts, he has put agriculture upon the same basis on which all other kinds of business have to be conducted. I believe that is the chief value, the great value, of the paper this morning, — that he has put forth here a basis upon which agriculture should be conducted, knowing the profits and losses in the business.

Following the last speaker carries me back to my own experience in trying to keep accounts with a dairy. I remember the first day that I hung the scales in my stable and prepared sheets for each man to record on a morning the amount of milk he had taken from the cows which he had milked. There was a protest at first upon the part of the men, and I had to inform them that they were paid for making those records just the same as for milking the cows, and that it should be exacted of them. They thought that it would make them extra trouble. I said, "I am paying you for all the trouble you are put to." The result was that in a short time these same men became more interested in their work than they ever had been before. They began to watch every day to see why there was a decline of 1 pound or 2 pounds of milk in their daily record. Whenever I reached the stable I always went to those records, and if I saw 2½ pounds short, I wanted to know the reason why. These men soon found that if they let the cattle out in cold weather, exposed to a low temperature, down went their record on the sheets in the stable; and if a cow failed to give her usual accounting, they ascertained the cause in some other way. In this way the very men who first objected became the most interested in vying with each other to show the biggest record at the end of the month. So it not only has a good effect upon the farmer himself, but has just the same on the men he employs; and that helps to raise the standard of agriculture and makes it a dignified business, puts it on the same basis as other kinds of business, and that is what we have wanted for a good many years. Agriculture has been con-

ducted in such a shiftless manner that it is not considered by many on the same business basis as other vocations; and until these principles are adopted and carried out, it can not stand squarely with other businesses in the community.

QUESTION. Do you lay stress upon saving your own seeds in any case and for any reason?

Mr. HOWARD. In my own case I save the seed from tomatoes and summer squash.

QUESTION. Lettuce?

Mr. HOWARD. No, sir; I wouldn't try on the lettuce. You can buy the California seed, which is fully developed and very nice, for 75 cents to $1 per pound.

QUESTION. Cabbage?

Mr. HOWARD. I do not practice saving any but those two that I spoke of. Market gardeners who raise cucumbers save their own seed, and a good many save their corn seed. Perhaps I ought to have included corn in that lot. I raise about an acre and a half of sweet corn every year, and that seed I have saved. I found it on the farm when I went there, and it seemed to be a very nice corn, — a strain of Crosby, which, planted any time in May, seems sure to be ready to harvest the second day of August. I can count on finding corn on the second day of August if I plant it any time in May; don't need to go down to see if it is there beforehand, but go down there and find it.

QUESTION. Do you save your own tomato seed?

Mr. HOWARD. Yes, sir.

QUESTION. What time did you select the fruit for saving the seed, — early, or late?

Mr. HOWARD. Just after the first set was formed, — not the very first. Tomatoes are commonly transplanted from the bed. On these plants is what is called the bed set, or first set; that seed we do not save, but take the next, which is more perfect in form, or the fruits are more perfect in form, and they are early enough. We select from plants which have the best specimens on them. I usually pick out a bushel of the best fruits that I can find on these specimen plants. I go through the fruit several times, sticking up stakes wherever I find a specimen plant. I allow several

fruits to mature, then go through and harvest those mature fruits, take them to the wash-house, allow them to get thoroughly ripe, pick out those which come nearest the type I desire, and throw the others away. That gives us a few very nice seeds. That brings the crop on earlier, planting from this select seed, so that now the greater part of our tomatoes are sold in the month of August, instead of the month of September. My returns from tomatoes in the past year have averaged 30 cents a plant.

QUESTION. How near together is the fruit?

Mr. HOWARD. The rows are 6½ feet apart, and the plants 3 feet apart in the row. The first tomatoes were picked the seventh day of July.

QUESTION. Do you trellis the plants, — support them in any way?

Mr. HOWARD. No, sir.

QUESTION. Trim off the top?

Mr. HOWARD. Trim the tops off, if they are too rank.

QUESTION. Don't they sprawl all over the ground, and lie down?

Mr. HOWARD. In the cultivation of tomatoes we ridge the ground: we plow up to them, and make a mound fully 10 inches higher than the space between the rows, and that over a distance of perhaps 2½ feet, which gives a nice ridge over which to lay the vines. We don't let the vines sprawl around; we go around and take each vine and lay it right out where it ought to be, a man on each side of the row; and then if the vines grow too rank, — too much wet weather or too much manure on the ground, — we take a sickle and cut those tops off, two men on a row, one on each side. That enables the fruit which is set to mature earlier. We don't care anything about the late tomatoes on those vines; if we want any late tomatoes, we set the plants especially for that.

QUESTION. What variety of tomatoes?

Mr. HOWARD. The variety which I have used has been Livingstone's Perfection. I have tried a number of other varieties, some proving quite satisfactory, and perhaps as good as the Perfection, but the Perfection has been good

enough for me. Strains vary; you may get a strain of one variety that would be worth twice as much as another strain.

Mr. Samuel Watts (of Natick). I followed the Boston market for thirty years, and it was very seldom that I failed to sell my products favorably. I live about 17 miles away. I grow cabbage, sweet corn, tomatoes, cauliflower, and a few cow beans. The lecturer has an advantage on the light stuff, he gets it there so much cheaper; but I have had good success this year on cabbage, tomatoes and corn. I have sold but very few tomatoes this year under $1. I raised the Stone tomatoes, cultivated my ground in very good shape, and put those plants down deep. After furrowing it out with a two-horse plow, I put a forkful of green cow manure in. A great many men in the market wouldn't believe me at first, but some people here know that I carried as good tomatoes to Boston this year as any one carried in. My idea is, that the Stone tomato is a fruit-grower, and when they are fruiting they want something to feed on. After I put in a forkful of green cow manure, I take a potato digger and make a hole in the centre: then I go on and plant three or four rows at a time, putting just enough dirt in the holes to cover them over; and I haven't lost a plant. Last year we had a frost rather early, and I cut them off with a sickle and stacked them, — worked pretty late one night. We had 1,000 plants; and I said to the men, "Just for the fun of it, count how many green tomatoes you shake off of the vine," and they shook 117 tomatoes off, after we had been picking for over a month. I came up here to-day, thinking to get some information, and, having seen some pretty good fruit, thought perhaps I might give some information. I think that cauliflower, cabbage and sweet corn are about as good crops as a man can raise who lives out about 15 to 17 miles from Boston, although I have averaged to go three days a week into Boston for quite a while. And for a milk-man — I am in the milk business as well — cabbage keeps the flow of milk up when the grass is dried up, so he gets a profit in milk as well as in selling the cabbage. I tell you, any one who hasn't tried it will be surprised to know the shrinkage in milk after you stop feeding a little cabbage.

QUESTION. How far apart do you plant corn which grows 4½ feet high?

Mr. HOWARD. I think the question was, how far apart should the hills of early sweet corn be planted, which grows 4½ feet high. The practice of our best gardeners around Boston is 4½ to 5 feet. A good many have planted the rows 5 feet and hills 20 inches apart.

QUESTION. That would allow other crops to grow in between, would it not?

Mr. HOWARD. Yes.

QUESTION. I mean just that one crop.

Mr. HOWARD. One farmer, located in Winchester, who grows 10 acres of sweet corn, plants all of his 5 feet apart. He puts nothing between the rows of corn. He irrigates that corn with water pumped by one of these pumps which delivers 120,000 gallons a day. He told me it cost him not over $5 a day to supply the water to that corn. His corn rows are about 600 to 700 feet long, and the water will run from one end of the piece to the other without going out of sight. On some land you can't do that. As soon as his corn is picked, which will be by the 25th or 28th of July, he sells the whole thing to milkmen in the neighborhood, plows the ground and plants it to celery, 5 feet apart; and he irrigates for the celery in the same way.

Mr. H. A. TURNER (of Norwell). I live some 25 miles from Boston, and in our vicinity we are trying to see what we can raise profitably; and most of the farmers are raising general products, and don't raise very much of anything, — that is the amount of it, — a little of this and a little of that. I want to ask Mr. Howard if he thinks he could succeed as well 25 or 30 miles from Boston as he does where he is. The land is cheap, but of course there are drawbacks, such as teaming the products to market. I would like to ask him if he thinks it advisable to carry on market gardening 25 to 30 miles from Boston?

Mr. HOWARD. It depends on the man. There are men within 4 miles of Boston who have done this year more than $75,000 worth of business, who cannot show 2 per cent profit on the business. Undoubtedly there are men who are 20 miles from the market who can show 20 per cent profit

on the amount of business done. Any man who has land and is raising stuff must study his market and his land, and see what his land will produce that he can sell in his market, wherever it is: and the greater price per bushel which the produce usually carries should govern him largely in selling market-garden products.

Mr. George M. Whitaker (of Winthrop). If the discussion of this question is over and the meeting is about to adjourn, there is a matter I would like to bring to your attention. I think it will be universally admitted that probably no one has, and certainly very few have, done as much for New England agriculture during the last forty years as Mr. A. W. Cheever of this State, who is now on his death-bed, although his mind is as clear as ever: and I move that the secretary be requested to wire Mr. Cheever this afternoon the greetings of this meeting, its cordial appreciation of his life work for agriculture, and its sincere sympathy in his suffering.

The motion was carried unanimously.

Adjourned at 12.15 p.m.

Afternoon Session.

The meeting was called to order at 2 p.m. by Secretary Ellsworth, who said: It is my pleasure to introduce to you Hon. William H. Spooner of Jamaica Plain, a member of the Board, who will preside this afternoon.

The Chair. Perhaps there is no subject connected with agriculture in Massachusetts that needs more attention than that of fruit culture. Two years ago I called at the office of one of our largest exporters of apples, and he showed me quotations from Liverpool, where Baldwin apples No. 1 and No. 2 from Maine were quoted, and No. 1 from Massachusetts, and the quotation for Massachusetts apples was less than the quotation for No. 2 from Maine. Now, I felt mortified at that. It seemed to me, as farmers, we ought to change that condition. This afternoon we have a lecture on "The soil: importance of its character for the culture of fruit." I have the pleasure of introducing to you Mr. George T. Powell, president of the Agricultural Experts Association, New York City.

THE SOIL: IMPORTANCE OF ITS CHARACTER FOR THE CULTURE OF FRUIT.

BY MR. GEORGE T. POWELL, NEW YORK CITY.

It gives me pleasure to meet you again, as heretofore, in the discussion of subjects which are of vital interest.

When we consider the possibilities of the soil in its power of production, its variety, its capacity for improvement and wealth-making, and its adaptability, it becomes an object of much interest.

The earth is a great storehouse, in which food is elaborated and prepared for plants and animals; and the more we study and investigate it, the greater the interest becomes to those who own a piece of land, to discover and bring out its wonderful possibilities.

One of the first problems of the owner of land is to know the character of the soil, its condition and its adaptability to the purposes for which he wants it. Upon the character of the soil depends very largely the success of those interested in its management. There is a wide difference in soils. There are the clays, sand, silt, shales, loams and muck, all differing in character. These are derived from the rock formations of different periods of past ages. In the early formation of the earth, ages of time elapsed before there was any form of life. Through the agency of water the rocks were washed and worn and disintegrated, until soil began to be made. Vegetable life, in turn, in its lower forms, began gradually to appear, and for ages it increased and decomposed, furnishing certain elements in the soil. Likewise animal life of land and water came into existence, and for generations and other ages their decomposed bodies

entered into the further formation of rock, there to be safely locked up for the future needs of the plant and animal life of the world.

At a later period in the world's history, great mountains of ice began, in their movements, the further work of soil-making. They plowed their way through the earth, grinding and pulverizing the rocks, leaving high mountains in their pathway, and dropping off and scattering the soil, rocks and stones of all sizes and periods of formation over wide plains, and leaving hills and valleys and rolling country, in all degrees of variation, behind them.

At this point I want to show you the difference in soils. The clay soils are made up of a large proportion of fine grains, and they are usually termed "heavy;" while the sandy soils are more largely composed of coarser grains, and are spoken of as "light." Clay loams and sandy loams are variations of clay and sand in the proportion and size of their soil grains. Silt is still finer in its soil particles than the clay, while muck is the product very largely of decomposed vegetable matter.

There is another kind of soil, known as hardpan. This is composed of fine particles of clay, and is deficient in humus or vegetable matter. The soil grains, being cemented together, are impervious to water, and nearly as hard as rock.

I here show you, by way of illustration, these different types of soil upon the chart.

It is of great importance, in all our operations in agriculture, that we have more definite knowledge regarding the soil with which we are working; and in the absence of this knowledge is to be found the reason for so many unsatisfactory results in agriculture.

This side of the chart represents what I have already spoken of as the clay types; this represents the fine soil particles; and this represents, below the clay, what is known as the clay loam, the difference being merely in the size of the soil grains. Upon the opposite side of the chart is the representation of the sandy types, — first the sandy soil, as we recognize it generally, and below the sandy loam here is the representation of the hardpan of which I spoke.

This represents different types of the shales and the gravel formations.

It is highly important, when we come to lay out our farms, whether it shall be dairying, the growing of general agricultural productions or the growing of fruits, that we have some definite knowledge regarding these different types of soils; because their relation to certain crops is vital, and if we get a wrong crop on the wrong type of soil, why, of course, we get two unfortunate things together.

Another point in the consideration of the soil is that of moisture. We here at the east do not have irrigation, except that it be done upon a small scale, where the most intensive methods of work are carried out; hence we have to depend largely upon other means for saving and for securing moisture. This is vitally important, when we come to consider the relation of soils to crops. The clay soil and clay loam are more moist, for the reason I have already given, — that they have finer soil grains, and, being closer together, hold and carry a larger amount of water and retain it for a much longer period; while with the sandy types, the soil grains being coarser and the soil being more open, evaporation is more rapid. You can see this in the illustration before you. In the heavy type the water, because of the fineness of the particles of the soil, has the ability to creep up slowly and is more readily available to the needs of plants; whereas, in the open, coarser soils the water has not the same ability or power to rise, and hence, as you see on the chart, it lies at a lower level.

These are very vital and important phases of the study of soils, about which every owner of land needs to understand something. I might mention, before leaving this part of the discussion, that it is of most vital importance in the ownership of land to know something of the character of hardpan, — where it lies; and a man should never purchase land unless he goes down and knows what is below, just as well as what is on the surface. If he purchases land where the hardpan strata lies near the surface, he is unfortunate. Because of its very retentive power in holding water, he is

restricted to certain lines of production, and he is troubled much in the growing of crops where he has land with this formation lying close to the surface. But, on the other hand, it is of extreme value if he can strike hardpan down to a certain depth, because it furnishes the ability to hold as a reservoir the percolating waters, to which plants may send down their roots through long periods of dry season, and there gain the moisture which they so much need.

It is of the highest importance, to those who desire to grow fruit and general farm crops, that they have some knowledge of these different kinds of soils, that they may get the kinds of trees and crops on the soil best adapted to their growth and development. I desire to emphasize this statement. For centuries the soil has been cultivated and made to produce food for the needs of the increasing millions of population, until at the present time much of it fails to respond liberally to further demands. That has been one of the great causes of our agricultural depreciation in the east. For many years we have been drawing upon the food supplies to that extent, without replacing the loss, that the soil has declined further to yield up of her abundance as liberally as she once did. Much of the plant food has not only been seriously depleted, but also one of its most important elements,— its organic matter. Its function is of the highest importance. It is of value to the soil in different ways. It improves its texture, enables it to more perfectly hold and to distribute moisture, and helps to make plant food more available; in fact, it is one of the great necessities of our present agriculture.

In the process of production for so long a time the humus of the soil has been largely used up or worn out, with the result that for years many sections of our country have failed to return profitable crops. One of the most important functions of humus is the improvement which it makes in the texture of the soil. It loosens and lightens a heavy clay, and softens and breaks down lumpy and cloddy conditions.

Now, take this type of land. Whoever knows clay land readily understands that the period in the spring in which

such land may be worked is limited. It must be taken just at the right time. If a clay soil is worked or cultivated when there is a superabundance of moisture, it is very difficult after that to get the land in good condition, because of its hard, lumpy character. Being possessed of a superabundance of water, being worked over at that time compacts it, and as soon as it dries of course it becomes hard and lumpy. Humus comes in here as a very important element to have incorporated in a clay soil, because it lengthens the period in which clay soil can be worked, and it can be worked with a higher degree of moisture in it.

The feeling roots of plants are delicate, of extreme fineness, and they cannot successfully seize upon clods or large soil particles. If we were to examine the roots of plants through a microscope, we would be surprised to see the large number of extremely fine, hairlike feeders that are pushing out in all directions in the soil. We cannot determine them with the naked eye, but by putting the glass upon them they present an astonishing number of these exceedingly delicate, fine roots, upon which the plant has to depend for its supply of water and of food.

The soil particles, then, must be fine, loose and soft in texture, for plants to obtain food, and a liberal amount of humus present will help to produce these conditions.

Another function of humus is to enable the soil to hold a much larger amount of moisture. In our forests the decay of leaves and roots, of fallen trees and branches, for generations, has given an amount of vegetable matter that will absorb immense quantities of water, which, during other and prolonged periods of drought, are gradually given off, and vegetation thereby carried on successfully in its growth. Since the clearing of our forests we have exposed this surface, which has been so richly filled with the vegetable decomposition of ages of time. We have exposed this, not only to the sunshine, and in the breaking up of the soil to the more rapid evaporation of water, but we have actually worn it out, with the result that at the present time our soils are compact, and water during heavy rains runs off rapidly; it is not absorbed in the same proportion as formerly by the

soil; it runs off rapidly into the ditches and streams, and the soil does not get as much benefit in recent years of the rainfall, because of this compactness from the loss of the humus which is so vitally necessary. Then, again, by not being able to absorb and hold so much water, when the dry periods come the soil dries quickly, and crops that used to go through dry periods without material suffering from drought to-day are seriously cut off.

The soil may contain an abundance of plant food, yet crops fail for want of sufficient moisture to make it soluble and available. The rainfall is often insufficient to meet the demands of growing crops, not only because of its deficiency in quantity, but of its unequal distribution. The dependence must be largely on that which is stored in the soil, and which is to be drawn on by plants at all times, and particularly in times of drought.

Another and very important function of humus is in the acids that are formed by the decay of plants, which act upon and make plant food more readily available. In the decay of plants they return to the soil that which has been taken out of it; and if clover, peas, beans and other legumes are used for plowing in, they will add nitrogen in liberal quantity, or sufficient to meet all demands and requirements of plants. This most essential plant food — nitrogen — is more readily lost than others, and of this many soils are greatly impoverished.

The next illustration shows how we can not only produce humus abundantly and economically, but also add nitrogen in its cheapest possible form. In the discussion this morning of that very admirable paper of Mr. Howard, you realized the importance of using freely of nitrogen, and not only of that but other elements of plant food in the growing of intensive market-gardening crops.

It is a problem, with the majority of farmers living 10 miles or more out of Boston, how to obtain extra fertilizer for their land. In the State Board meeting there are comparatively few farmers, market gardeners, or fruit growers who live within 5 miles of Boston. Many of you live out perhaps 25 or 50 miles and farther, and you have not the same

advantages in obtaining the city supplies of manure. Now, it is as vitally important that the soil 50 or 100 miles from the city be kept up, as that only 5 or 10 miles away. This may be done through an economical method, which I am glad to be able to give to you this afternoon. In our system, where we use rotation in cultivation, there is no more economical manner in which to keep up soil fertility, to supply lost humus and add to it what it so much needs to-day, — the most expensive element of plant food, nitrogen, — than through the aid of leguminous plants. The clover as represented in the chart fills the soil with a mass of roots. The tap root goes down deep, as far as the soil is open or congenial enough to let it work its passage downward. It goes down and brings up the potash, the phosphoric acid and some nitrogen that may be deep in the subsoil, — brings it up to the surface in the construction of the plant itself. Not only that, but upon all of the fine roots which are here represented are the nitrogen nodules. We have heard much recently of this principle of inoculation of the soil artificially through nitrogen bacteria, which our United States Department of Agriculture has been so ably and so thoroughly bringing before the public. Upon its roots the clover plant has the ability to form these nodules, which, acting in conjunction with bacterial influences in the soil, take up the free nitrogen of the atmosphere, and in their disintegration give it to the soil in the cheapest possible form in which it may be obtained. In our system at "Orchard Farm," which is that of fruit growing, wherever it is possible we co-operate with the clover plant, because of its wonderful ability not only to restore to the soil an abundance of humus, but also of nitrogen.

Here we can see the difference between plants. This illustration represents the timothy plant. You see the character of its roots. Those who can see them will observe that they are rather fine. They are close to the surface, they do not run down deeply; with the result that they take the plant food from a very shallow surface of the soil, — are surface-feeding. In following the timothy sward with corn or potatoes, or with any farm crop, any farmer present

knows he gets no such results as in following the clover plant, for the reason that the preceding timothy crop has drawn upon the plant food in the same depth of soil which the roots of other plants call upon for food, and hence they find a somewhat impoverished soil. The clover, on the other hand, draws up from the depths beneath an abundance of plant food, and leaves it close to the surface, where other plants may use it. I want to emphasize especially this afternoon the importance of a careful study of the leguminous plants. We should use them in every possible way in the growing of our farm crops.

Soils may be improved in several ways: by tillage, which is one of the first in importance, for through tillage the soil must first be put in proper condition for the growing of plants of whatever kind desired. Plowing and after-tillage are essential to be understood in relation to the effects produced upon the crops to be grown.

We have not yet reached the point of the best culture of our soil; there is too much crude practice in this very important operation. Through tillage alone great improvement may be made in most soils, as they contain more or less of potential plant food, but in unavailable form. Unless the mechanical condition of the soil is right, the expenditure of money for fertilizers will not be productive of profitable or satisfactory results. Hence good tillage is one of the first and most valuable processes to be employed in soil improvement.

I want to emphasize again the value and the importance of thorough tillage. It is seldom that I see anywhere in the preparation of land for a cereal crop, anything like adequate tillage given to the soil. Two or three more harrowings or cultivations would add bushels at the harvest time; and yet too often farmers in their haste will not give the time necessary to reduce the soil to the fine condition in which the plants which are to occupy it may obtain the plant food which is there abundantly. No, farmers do not spend money for chemical fertilizers until you have at least worked out some portion of plant food in the soil which is there and ready for use; it is much wiser to put the labor upon the land, and

get it there, than it is to spend money for the chemical fertilizers, for in this condition of soil the fertilizers cannot act, and the plants cannot get the good from them. Fertilizers are condemned frequently by farmers because they do not always get good results from their use. You would get them by giving the soil higher tillage and more of it before the seed is put in.

Stable manures may be used to improve the texture of the soil; they furnish not only humus, but plant food. Where stock may be kept to advantage, and the manure they produce is properly handled and applied, the effect is always good and lasting. Unfortunately, the manure produced upon many farms is so unwisely treated that much of its value is lost before it reaches the field. When allowed to heat, or reach a high degree of fermentation, it loses much of its nitrogen; while its value is often largely depreciated by exposure to rains that wash out much of its soluble matter.

Not long since I was called upon to make an examination of a large property, to outline what might be done to improve the general conditions of the property. The land was running down; it was unproductive. The owner felt that for some reason his landed interests were a burden to him, and he was not getting from them what he desired. It was a property of over 1,000 acres. A large quantity of stock was kept upon it, and as I went through the stables to examine their sanitary conditions, and the effect which might be produced upon the milk that came from them, to examine the food, the rations that were being fed, and then started from the barn and the stables to go to the fields to see the condition there, I happened to go by the manure pile. I learned that the manure was carted out from the stables daily. There was a large number of cattle, several hundred head of swine and a flock of sheep, and the manure was carted out daily and dumped into a great pile; and in going out to examine the land I suddenly came upon a ditch, over which I had to jump; and in the ditch was a running stream of liquor from this great manure pile, containing perhaps 1,500 loads of manure. A little farther on

I discovered an open sewer, into which this liquid manure was running. It did not take long to make a report upon the management. The land showed what little of the value of that manure went back to it. The higher value in stable manures is in the liquid parts, — the value is about three-fifths in the liquid and two-fifths in the solids; and yet in this instance it was running away by the hogshead every day, and I might say every hour, — running away into a sewer, instead of going back upon the land. It is highly important that we carefully study this problem of our stable manures, and allow no waste.

I have dwelt thus long upon the soil because I feel its importance. I have perhaps given more time to the discussion of this phase of the subject than I shall to that of fruit culture, which I shall now take up, because I feel that the future success of our farmers depends so largely upon the upbuilding of the soil. We must use every possible means for conserving plant food, because in the future we want to make even greater demands upon it than we have in the past. Hence I have given this time to this part of the discussion.

Fruit has the highest value of any of our productions. In the culture of fruit to-day one of the first duties of the grower is to adopt systematic methods of improving the soil upon which it is to be grown. The land for fruit culture should be selected with reference to the kind of fruit to be grown. Here again let me use the soil chart. The ideal soil for most tree fruits is a deep, rich, clay loam; and especially is this true for apples, pears and plums. This is the type that is best adapted to these three fruits. The clay soil seems to carry more evenly in its organization the moisture which is required by trees than the more open, sandy soils. Our tree fruits are a little longer perfecting, and hence a soil that will carry moisture over a long period of dry weather is better adapted to trees. Small fruits are well adapted to sandy soils, because of the shorter period in which they mature. In planting orchards it is always desirable, if possible, to select soil that has some clay in it. The clay loam is admirable, exceedingly so, for fruit of nearly all kinds; where you can get a loamy soil, with a small per cent

of clay in it, it is excellent. However, if you have a sandy loam, certain treatment can be given to this soil which will give excellent results in growing tree fruits. It is an interesting fact that upon Long Island, and in other sections where the soil is very open and sandy, there is more or less variation in the character of the land, small percentages of loam and clay appearing; and upon these loamy sands some excellent apple orchards are to be found.

The finest grapes are those that are grown upon the shale, represented in this type. The shale and the gravel will produce the finest grapes. You will get a sweeter grape grown upon the shale than upon the clay, for the reason that it does not hold quite so much moisture. It is a warmer soil. It is generally rich in phosphoric acid and potash, and that will give you a sweeter grape. Grapes on shales, and peaches on sandy loams; peaches do best on the sandy loam. For peaches, I would always choose the sandy loam, although good peaches are grown on clay loam.

Most valuable service is being rendered to farmers and fruit growers by the United States Department of Agriculture in the soil surveys which are being made in different sections of the country, to determine the adaptability of the soil to different crops. Farmers and fruit growers will find great benefit in procuring the reports of the surveys and investigations which are published, and from them studying their own individual farms, and cultivating more largely those crops for which their soil is best adapted. I think the department has never done more valuable service than in making these surveys, and carefully studying the geological character of the soil and its adaptability to crops that may best be grown upon it. It is most invaluable service, and gives to owners of land new advantages in its management.

There is much land in New England that is well adapted to fruit growing. That in the more northern portions is well adapted to the production of apples. The land in Massachusetts, especially in the eastern part, produces pears of fine quality and of the highest value. I have always

noted, in our New York market, that after the holidays the high-priced pears are those that come from the vicinity of Boston and Worcester. The Boston box pears are brought out after the holidays, and always command a high price. The soil in portions of Connecticut has no superior for the growing of peaches.

Now, in all of the New England States, by simply studying this question of adaptability of soil to the product, there may be grown excellent fruits of all kinds, with the exception of peaches and cherries in the more northern portions.

While apples are grown among the rocks and uncultivated fields on many of the hill farms of New England, they are by no means the best apples. The trees grown in those rough places cannot receive the care and cultivation required, and fully 75 per cent of the fruit is so injured by the codling moth and other insects that its value frequently is but little above the cost of barrels, freight and other shipping expenses.

There is much discussion of the system of growing trees with mulch, rather than by cultivation. While the soil may be improved by a mulch, there will be more rapid improvement made through cultivation and the plowing in of green manure crops. For fifteen years we have been following the plan of cultivating the soil among trees up to July 1, and then sowing crimson and red clover, which are allowed to grow the balance of the season, to be plowed in the following spring.

One of the great disadvantages of the mulch system is the large amount of water which grass will abstract from the soil, in addition to that which is required by the trees. A well-grown apple tree, with an abundance of unimpaired foliage, will take up from the soil and transpire through its foliage every twenty-four hours during the warm days of June and July over 4 tons of water; an acre of grass during the same time will take up daily and pass out of the soil over 100 tons of water; and in times of drought trees and fruit suffer alike from this great absorption of water by the grass that is growing for the purpose of a mulch. We can hardly realize this fact, but when the hot days of June

and July come on, it is astonishing what great demands are made for water by fruit trees and grass that are occupying the soil. Unless this amount of water comes, positively they must perish. Of course in the great subterranean supplies which are underneath our farms everywhere this large quantity of water is constantly finding its way to the surface. The higher the temperature of the atmosphere over the surface of the soil, the greater becomes the pressure of the water from below. If it were not for this principle, vegetation could not exist. As I have already stated, our annual rainfall is so unequally distributed that if plants had to depend upon it through the growing season they would very often fail. This mulch system may possibly be successfully adopted for a time where an orchard is situated on a natural water-shed, where the water is constantly supplied by the higher land, or where there is an inexhaustible subsoil supply.

I want to give here an illustration of the danger in accepting a new plan without giving it a most careful trial. A few years ago I laid out the plan for an extensive apple orchard on a farm in a New England State. I had been called upon to examine the land, and to determine its adaptability to the growing of apples. I found the soil most superior for that purpose, the elevation good and the quality of the apples in the locality most excellent. All the conditions seemed to be present for the establishment of an exceedingly valuable orchard. Twenty thousand trees were set out. The advice was followed for two years on the line of careful culture. During those two years the trees made exceptionally fine growth. The plan then was to top-work the trees, which I will discuss a little later. But in the mean time the policy was changed to that of mulching the trees. A dry season followed, when the top-working or the budding was to be done. The budding was practically a failure; the trees stopped growth. During the following winter mice collected in the mulch, as hay was drawn and put about the trees in addition to the grass that was cut and placed about them. The following season the trees declined still more, with the result that the advice was given that,

unless the mulch system was changed, the orchard, which was so promising and so beautiful in its growth, would be an absolute failure and a total loss. The system was changed back again to cultivation, with the result that the trees have taken a new start, and are giving promise now of a good orchard in the future, although by the change of system at least four years of time had been lost. So that, while we may discuss this question of mulching, every man must decide for himself whether he has the conditions that are right for it, before he ventures to adopt the practice upon a large scale.

In my own case I gave this system a practical demonstration. Five years ago I planted two orchards, one to be given cultivation and the other to be kept under the mulch plan, that I might test them side by side, under my personal observation. The trees that have been cultivated have continued to make very satisfactory growth. They have already begun to bear fruit, this past autumn being the fourth year. Some varieties have borne liberally, from 15 to 20 apples appearing upon a tree. Now, the other orchard that has been kept in mulch has practically made not more than half the growth of the other. A number of the trees have failed. The grass came in heavy, and it so taxed the soil for moisture during two dry seasons that many of the trees died, and the orchard has been reset once with nearly one-half the number of trees that have died out. So that at my own farm I am clearly satisfied that this system of growing fruit trees by mulch is not at all adapted; and I think that my farm represents about the average of the farms of New England, in the character of its soil and in the management which it requires. The mulch system, which has been so attractive, as doing away with a vast amount of labor, with most men certainly will prove to be misleading and disappointing.

The majority of New England orchards are on hillsides, on comparatively dry land, and in sod; and so long as apples are dependent on such conditions, the crops will not only be uncertain in yield, but the quality will be largely inferior. It is wiser to give to orchard purposes a few acres of the best land, and devote it entirely to the trees.

Our present system is to plant permanent varieties of apples 40 feet apart each way, and interplant with fillers of early bearing kinds 20 feet each way; and we are trying the experiment of again interplanting with dwarf trees 10 feet apart, with clean culture in the early part of the season and cover crops of clover. The soil is expected not only to carry this large number of trees to bearing age, but to be steadily improved at the same time.

We have one orchard planted by my father fifty-eight years ago, the trees standing 33 feet apart. The soil is completely filled with interlacing roots. For many years the orchard was in sod, bearing crops quite regularly, in which was a large per cent of inferior fruit. For several years it has been under high tillage, with crimson and red clover sown annually at the rate of 15 pounds of seed to the acre in June or early July, and plowed in each spring; with the result that the soil has not only steadily improved, but the crops of 1904 and 1905 have never been exceeded in quantity or in quality, and have never sold for so high value.

I want to say, in connection with this, that the orchard has not had a dollar's worth of other fertilizers applied during thirty years. I am testing this matter to an extreme. It only goes to prove what I have already stated, — that much of our soil is rich in mineral plant food to-day, with all we have taken from it. There are thousands of acres of land to-day that are considered reduced, worn out and useless, that are not so by any means. They are abundantly supplied with mineral plant food. Let us supplement that now by the liberal use of green crops plowed in, and we shall find that we may grow profitable crops even without the aid of commercial fertilizers. We must get more from our land.

If there were more time, I need only refer to the culture of the soil as it is carried out in England, in France, in Belgium, in Denmark and in Italy, to show that after thousands of years of cultivation they are getting yields of crops that surprise us. I have known of instances around Paris where a single acre of land, in the growing of garden crops and very often fruit crops, is yielding over $2,000 to-day, and upon which an annual rental of $250 is paid.

Often a rental of $400 is paid for a single acre of land. When we come to consider the possibilities of the improvement of land, we in our country know but little about it as yet, because we have had so much land, we have worked over an extensive surface, and we have never been driven to the necessity of taking a small acreage and working out of it its great possibilities.

While it is admissible to grow other crops in young orchards if extra fertilizing is done, the profits of the orchard will be greater in future years if the entire use of the land is given to the trees; and under these conditions the close interplanting may be possible if the trees are given the entire resources of the soil. When the interplanted or filler trees begin to grow upon the others, they must be removed, — first the dwarfs on Paradise stock, and later the half dwarfs on Doucin, or of standards of early bearing kinds; these must be removed as soon as they begin to encroach upon the space of the permanent trees. Herein lies the danger in recommending this system of close planting of trees, for, while the fillers are bearing liberal crops of fine fruit, the temptation will be strong to leave the trees for one more crop, and still another, until without great care the soil will become so taxed and depleted that the entire orchard will fail to produce, and the plan will prove a failure. It requires considerable nerve to send in men to cut down three-fourths of the trees in an orchard when they are regularly producing good crops of fruit; but this must be done at such time as is demanded by the permanent trees, which are to occupy the land for upwards of three-fourths of a century, with profitable production.

There will be advantage to the soil, as well as to the trees, by starting them with low heads. On land that is naturally well drained, the shading of the ground by low-headed trees will lessen somewhat the great evaporation of water during the hot period. While the fine tilth produced by frequent cultivation serves as an excellent mulch, a partial shading of the soil will be an additional help in conserving moisture through the hot season. Low trees will be an advantage in saving drain upon the soil, by making

practicable the thinning of the fruit. By preventing the growth of all imperfect fruit and the growth of an excessive quantity, there is a saving of the plant food which is required to perfect the fruit year after year. Thinning fruit is impracticable on high and very large trees, as too much time is required to get over and about them; on low trees this is possible; and where this work is done, there may be obtained a very much larger per cent of high-grade fruit. No less important is the low tree in its relation to the work of controlling insects and diseases. Spraying is now as essential a part of the work of orcharding as cultivation, and this may be much better done upon low trees.

We are giving some attention to the culture of dwarf trees. While these have been used in pear culture on a commercial scale, dwarf apple culture has not been attempted in any commercial way. This can only be done by specialists. In dwarf culture a much higher system of tillage must be practised. The soil must be more thoroughly enriched, as a greater number of trees are planted upon an acre.

With the general spread of the San José scale and the inevitable spread of the gypsy and brown-tail moths, so serious in their depredations about Boston, the necessity of planting trees of low growth that may be most readily treated to control these insects, and others that may at any time be imported, will be forced more and more upon us. We are starting all standard trees with heads 2½ feet, and dwarfs from 10 to 12 inches, from the ground. We are doing this in anticipation of the gypsy and brown-tail moths in time reaching our territory.

Dwarf trees on Paradise stock may be planted 8 feet apart each way, which will require 680 trees to the acre. These may be allowed to bear for several years, after which every other row each way may be cut out, leaving the balance 16 feet apart. With this very intensive method of culture and close planting the soil must be thoroughly enriched, and made to support the large demands made upon it. This may be successfully done by the growing of leguminous crops, with the addition of 500 or 1,000 pounds of potash

and bone, with 2,000 pounds of lime applied per acre as often as the growth and condition of the trees indicate their need.

Land has been so abundant and cheap in our country that we have gone on producing from large areas without giving much thought or attention to keeping up the productivity of the soil, or applying careful methods for its improvement and the restoration of the loss caused by continuous production. We know little of the possibilities of an acre of land, and the dwarf trees, calling for a much higher degree of culture, will be a means of leading up to more intensive methods.

During the past season we succeeded in carrying over a large peach crop through a most serious drought by very frequent tillage. The land was planted to apples, with peaches between; but I do not recommend to you this sort of planting. Let us plant apples on blocks of apples; let us plant peaches only on blocks where peaches are to stand; and so with all other fruits. If we attempt to spray full-strength Bordeaux mixture on apple trees with a row of peach trees running between them, we shall ruin the peach foliage, and hence it is not a wise plan to follow.

But both of these were carrying large crops. A drought started in when the fruit was not half grown, and it continued until after the peaches were picked. As the fruit began to approach maturity during the prolonged dry weather, the soil was harrowed lightly every day, this being done even while the fruit was being picked. We had no rain to wet the soil from the time the fruit set until the crop was picked. The result was that the entire crop was brought through and sold for prices much above the general market quotations. The market had last year a vast number of peaches, of which one dealer said to me in Boston, in describing the fruit that came on the market, "There are so many of them that are composed of nothing but pit, skin and fuzz."

The soil around this orchard had been well supplied with humus from several years of clover cover-crops, which were a great aid in addition to tillage in conserving moisture. To test the possible advantage of adding nitrogen to aid in

obtaining a larger size in peaches, from 8 to 16 pounds of nitrate of soda were applied to a tree, a few trees on the end of each row being left as checks, to note the result. Not the least effect could be observed from the application of the nitrate of soda, through any growth of wood or any increased size of fruit. Without doubt the clover had supplied all of the nitrogen that the trees required. Five years ago, on other trees where clover had not been previously used, from 20 to 30 pounds of nitrate of soda were applied to single trees, they in this instance being plums. The effects have been marked. Not only have the trees made very much larger growth, but the fruit each year since has also been superior in size.

After still further experience in the propagation of trees through the selection of buds from trees of certain fixed characteristics and quality, I am more strongly convinced of the value of the principle. During the past year, while there has been a generally light yield of apples in all sections of our country, the quality of which has been much below the best standard, we have been enabled to take fruit not only of very large yield, but of the highest quality to be desired, from trees that have been grown from this principle of top-working through bud selection. There is, without any question of doubt, as much value in selecting buds from strong, typical trees from which to establish orchards, as there is in laying the foundation of a superior herd, or in building up any class of animals from carefully selected individuals. Not only have the trees thus propagated shown vigor and vitality, but they have been able to resist the unfavorable conditions which so often attend the period of blooming. The apple crop generally over the country was exceedingly promising in the spring. The set of blossoms was unusually heavy, but there came unfavorable weather conditions during the period of bloom, with the result of a very light set of fruit, with a consequent light yield at harvest time.

We are still following the principle of top-working and bud selection, and have stronger faith in its value in the establishment of orchards.

I will illustrate this method very briefly upon the chart.

Our method is simply this. We purchase from the nursery good, strong, vigorous two-year-old Northern Spy trees. I have always held to the Northern Spy, for the reason that it is a hard, fine-grained wood; it is a strong tree in its root, and vigorous in its growth of wood. For these reasons I have held as much as possible to the Northern Spy as the stock upon which to carry out this plan of top-working. I think there are other trees which would be equally valuable for top-working, but I have always used the Northern Spy. Originally I grafted, taking the branches as they were well developed, and inserting grafts in three or four of the main branches of the tree; but in recent years I do not buy the heaviest stock, I generally buy trees two years old. We cannot always get trees that are headed low enough; hence I begin budding down within 30 inches of the ground, and set the buds in the body. Then, to make sure, we set a few of the buds in the upper branches, so that in case of failure of some of the buds we have still enough to make our tree the first year of budding. That is the general practice we follow at our orchard farm. I will give you the results of fifteen years of this work. Fifteen years ago I began with the King, and we know the King is very susceptible to apple canker. We cannot get the tree through fifteen years without its being broken, and in some sections of our country I have seen 90 per cent of the trees go out from disease. But from their scarcity I am getting a high price for King apples to-day, simply because the fruit is in such demand and is so highly prized. Upon this orchard, grafted fifteen years ago, there is not the first evidence of disease upon a single tree. They are magnificent trees, in full growth, and making fine development. They have borne for seven years in succession very excellent crops, so that this system of top-working the King on hardy trees has thus far proved a success. The buds were selected from ideal trees, — trees that were strong and vigorous and typical; and they have certainly carried out the quality which was possessed by the tree from which the buds were taken. I believe it is possible for us to take other very choice, delicate varieties, and, by transferring

them to vigorous stock, grow apples that cannot be profitably grown in any other way.

Just one more illustration, and I will bring my discussion to a close.

For several years I have been much interested in growing currants. I began upon the same line a number of years ago for the development of a more prolific type of currant. I found in New York State that the average yield does not exceed 3 quarts to the bush; but in my plantation I observed, as the pickers came in with their trays of fruit, that there was a difference in the size of the currants from the different bushes. Observing this difference in the size of the currants, I have gone back to the bush from which they came, and I found invariably that those large, magnificent clusters came from bushes which were large yielders. A stake was driven down and the bush marked, and cuttings from the bush were taken. The foreman was instructed that when a very fine specimen came in, some one must be despatched to where it came from, to mark the bush and later take cuttings from it.

This illustration on the chart was taken from a bush bearing fruit of this character. Just on the opposite side, in a row only 5 feet distant from it, stood a bush of this character; upon the entire bush there was just one stem, set with one very lonely currant upon it, — that is all the fruit there was upon the bush. Now, suppose we should go right through, as is the general practice, and take cuttings irrespective of the character of the bush. If we took cuttings from this type, you can see at once the disappointment that would follow in the probable yield; whereas, if we took cuttings from this plant, we may increase the yield per bush from 3 quarts to 16, as in this instance. The bush from which this illustration was taken produced 16 quarts of currants, and it is from this type that we propagate.

QUESTION. What variety?

MR. POWELL. These are Fay's Prolific. You can get the same results with other varieties.

Owners of land must each work out for themselves these problems, of which there are many. They are so full of

value and of so great importance, that real interest attaches to the work. The land with its great possibilities is attracting large numbers of business men and others in our cities, not only to its ownership, but to its best development along scientific and business lines. There is an active demand at the present time for farms, and much less is said of abandoned farms than at any time. They are being bought up, the land is again being brought into cultivation, buildings are being repaired, dairies of good cows are being brought to these farms, and orchards are being planted of carefully selected trees that have been as well bred as the cattle.

The recent report of the Secretary of Agriculture gives some astonishing facts. What the department has done for a better agriculture is almost beyond comprehension, and when we consider the enormous wealth, that agriculture has produced, under crude methods, what are the possibilities in the soil when we shall bring to it greater scientific knowledge, practically applied?

Never in the history of our agriculture has so much interest, so much intelligent thought, been given to land, to the soil, to the possibilities that may be realized in its improvement and future development, as at the present time. While our cities are growing at a marvellous rate, and they are filled and crowded by many who are seeking to acquire great fortunes, — some, unfortunately, in doubtful ways, — it is hopeful and healthful to note this tendency, now so marked, back to the land, where, if money is not made as fast, a kind of life is developed by living in close touch with nature that makes a better citizenship, and the promulgation of principles that underlie good, just and stable government.

Mr. B. P. Ware (of Marblehead). While I have no doubt the lecture has been of great interest and very profitable, my hearing is so imperfect that I really am not in a condition to discuss the subject. I feel that fruit culture for Massachusetts is of vital importance, and especially that of the apple, although in coming over the road I saw a great many old orchards that were quite neglected, and were of little or no value. Yet I believe to-day that there is no

better opportunity for young men starting out in life, where they can buy lands with soil admirably adapted to that purpose, than to enter into the culture of the apple. While our chairman has told us that he has learned, by studying the quotations of the market, that Massachusetts Baldwins only brought the same price in England, first quality, as the second quality in Maine brought, which is certainly a discredit to us Massachusetts orchardists, yet I believe we can do better. It requires not only skill, but effort and perseverance. In order to succeed in apple growing, or with any other crop which we farmers grow, we must work not only with skill and knowledge, but with perseverance.

Hon. J. W. Stockwell (of Sutton). I have been very much interested, as I always am in hearing a lecture of Mr. Powell's. I am always glad he can come to Massachusetts, because he gives us so much to think about; because his experiments and his experience are worth something to us. They are founded upon fact, they are founded upon keen insight, they are founded upon true principles; and therefore, when we introduce what he has said into the book which will be printed, we know we have something that is worth while for Massachusetts to print and send out broadcast, — something we can be proud of wherever it is read; and we know it is read not only throughout the United States, but in other countries. I believe, speaking from experience and from knowledge, it is the best-read agricultural report that is printed in the United States.

Now, with reference to the apple, — the Sutton Beauty apple, on which your chairman has asked me to speak. It originated in Sutton, in an orchard about two miles from my old home; for many years it was known only locally, till the increasing demand for this particular apple and the higher price in the market led to the giving it a name and wider notice, and to-day it stands as one of the foremost market apples, and deservedly so.

The Sutton Beauty is an apple we Suttonians are all proud of, and I believe it is one of the apples that are going to take a very forward rank in this country. It brings a price perhaps equal to the King, certainly in this market. The

only trouble with it is, it is inclined to overbear, and unless care is taken, we will lose in the end, for the tree will overwork itself. If it can have proper culture, if it can have proper pruning, if the yield can be thinned to the best advantage, there is no apple in the world that can stand ahead of the Sutton Beauty, — color, form and quality considered.

I would like to speak of apples originating in Massachusetts. I was led, in connection with my work for the St. Louis Exposition, to carefully compile and arrange the list of apples first grown and named in Massachusetts; and my list, carefully collated, and without one of doubtful origin included, was ninety-seven varieties. Among them will be found a large proportion of the most valuable market varieties of to-day. Some of these apples, both productive and delicious, are being lost because they are not "market" varieties: and this is such a commercial age that the "market" rules us all. Plant a hundred acres to apple orchard, and none of our lecturers would advise to exceed twelve varieties, and some of these not for excellence, but for the "market." I sometimes wish some enterprising farmer, with the flavor of the good old times in his heart, would endow a farm for perpetuating delicious but unprofitable varieties, that are so rapidly being lost to view, though to memory dear.

The CHAIR. I have noticed, in travelling about the State, some old and neglected orchards; and the query has been made to me, whether those orchards were worth improving. Would it pay to regraft those trees, or would it be better to cut them down to the ground? Some one has suggested to me that that is the best method of improvement, — to cut them down to the ground, let them grow up their suckers, and then bud them. It is, perhaps, a practical question.

Mr. POWELL. That question comes to me frequently. I have during the past year looked over perhaps not less than twenty different farms for purchasers, and have found upon them invariably old apple orchards. It is surprising to note the extent to which city people are buying farms to-day. It is a part of my work to give judgment upon lands for the

people who are purchasers, and I find this very question coming to me so often. My advice to all the buyers of these farms is this: To at once appropriate 10 or 20 or 30 acres of the best land, and set out a new orchard. They are all more or less interested in growing trees. While this is being done and good care is being taken of the young trees, they can work on the old trees. Trim up the old trees, if they are not too old and too high, give them a good pruning, clover the land, spray them thoroughly, and they will still continue to yield good fruit for the years while the young orchards are developing. In the mean time, the San José scale is going to clean them out, because it is spreading everywhere. It is surprising how that scale is getting over all the trees in New York State, particularly the southern portion, Connecticut, New Jersey and all southern States. The scale is just sweeping through the country, and that is why I advocate these low-headed trees, where the spraying may be done effectively, where we may grow, as dwarf trees, trees such as this very excellent Sutton Beauty. I consider that the very great bearing quality of the Sutton may make it an exceedingly valuable tree to be grown as a dwarf tree, because on a low tree the thinning is a practical thing to be done. So I would say to you agriculturists here, experiment. I don't know about dwarf trees, — it is a new culture; I am testing it, and am growing on a commercial scale, but I can't give any advice as to the results, or the probable results, as yet. So I would say, appropriate a good piece of ground for young trees, then take as good care as you can of the old trees for a few years, get all the fruit you can from them, and then clean them off right to the ground.

Mr. Elmer D. Howe (of Marlborough). The speaker advocates starting trees at a distance of about 20 inches from the ground, and also advocates interplanting an orchard. I was wondering what kind of a tree you could get under a 20-inch tree.

Mr. Powell. That is a very practical question indeed, but this system of close planting, of course, necessarily carries with it a very thorough system of pruning. You

cannot let these trees grow all over and occupy the ground, as we have done with our usual standard trees; hence we must begin to prune in, which means a system of heading in annually of these trees. That will solve in part the question of cultivation. Then, again, we have got to have improved machinery, and we are getting it already, where the horse can go through the centre of the spaces and the machine go in under the trees, where it would be impossible for a horse, or even a mule, to go. As this system is taken up and adopted, and we find the necessity of a different kind of machine to cultivate, we shall have it. I am using now a sort of a plow to start with, which is reversible. We can push the beam off to one side, and yet the share of the plow will run quite close up under the branches of the trees. You can reverse it either way, so that the plow, even with a horse, can plow right under the trees, where you wouldn't think anything could be done at all. But we want something better than that, — something on the idea of the Morgan carpet hoe. We have it in part in the extension cut-away harrow that can be pushed out. These cutting shears are only about 15 or 16 inches in diameter. They will cut the soil both ways. In the culture of our trees we don't need to do the plowing that we once did, — we simply want to stir the surface: and the cut-away, unless the soil is too stony, will go down 3 or 4 inches, — plenty enough to stir the soil, — so we can go back and forth and pulverize the soil and not plow it as we have been accustomed to doing. Of course, as the dwarf trees grow out we widen our spaces, which leaves room for this system of cultivation.

Mr. Howe. How did you weigh that several tons of water which was taken up?

Mr. Powell. My authority, of course, is the scientific work that has been done in so many stations in our own country, in taking the actual quantity of water that is used by trees and plants during every twenty-four hours, — scientific experiments.

Mr. H. R. Kinney (of Worcester). I have been very much interested in the policy outlined this afternoon, and

probably it is all right in some places, but I have my doubts about the low-headed trees in Massachusetts. I was brought up in the belief that you could let trees alone, and have them raise good fruit. I travel about the State considerably, and know one orchard where a gentleman used to raise the best fruit shown in Boston. I had the good fortune to be there, but his fruit began to be poor, and he complained how he allowed his trees to get low, and that the sun hardly shone on the trees; they were not thick, only the branches came low down and shaded the ground. In my own experience in this section I don't know a single apple tree that grows fine fruit year after year where the branches grow low down. My own method would be to allow the sun to shine on every bit of the ground every day. I think that low heading is wrong in every sense of the word. I am not saying that letting the limbs go down is not good. If you start those heads at, say 2 feet or 3 feet, where will your limbs be? I never have seen an apple tree that it was possible to keep the limbs up; as the fruit began to grow, the limbs would go down, and down, and down, making it necessary to prop them up. On the other hand, with all such varieties as Greenings and all low-growing trees, it is impossible to keep them up. They may be started at 6 feet high, and in two years the limbs will lie on the ground. Take the Northern Spy, and such trees as those; you start them in the ground, and they will keep up all right. But advocating starting trees low, which will necessitate in a few years cutting off the large limbs, I think is wrong. The King is another that it is almost impossible to keep up. I don't care how low or how high you start it, it will go down.

Mr. E. Moore (of Worcester). There is one other point; that is, in selecting the Baldwin apple or any other apple, or the peach or the plum, you will almost invariably find the best specimens in the highest branches. If I go to select fruit for exhibition, I go right into the centre of the tree, if I can reach them with my picker, and I always find the best fruit away up to the top of the tree. I tried one year fruiting some of the lower limbs, picking the fruit,

thinning it very much, to get some exhibit specimens. In not one case in ten did I get a show apple, pear or peach. The best specimens were all up in the high branches.

Mr. Powell. I am very glad to have these questions come out, as it is the only way to get at things truthfully. I appreciate what the gentleman said in regard to these low limbs, and I know it is a fact that if they are grown as we usually grow trees, there will be a lot of poor fruit on these lower branches; but my idea is this, that we have got to do more pruning of our trees. We must let the sunlight through on a low-branched tree, but it will shine right through that tree upon the ground, under my system. That means taking out a good deal of the wood; it doesn't mean letting all the wood grow that we have on our standard trees.

Now, in regard to my Kings. They were started 4½ inches from the ground, and they are all on the ground, covered with fruit. We start our cultivation early. I don't believe in keeping up cultivation too long. Simply in the spring plow in this clover, then give your ground a few harrowings, and seed right back again, — that is, according to the season. This season dry weather struck in, and we kept up our cultivation as long as the dry weather lasted. We kept it up six weeks longer than we otherwise would, because there seemed to be a promised continuation of dry weather. The result was, we brought our fruit through, fine size, beautiful quality and splendid color.

Question. Have you any clover for next year?

Mr. Powell. We have clover 16 inches high under those trees to-day. That is where this system of cultivation has its value. This practice of frequent cultivation puts your land in the finest tilt. It increases plant food, so, if you sell your fruit early or late, you are sure to get a profit. I haven't failed in sowing clover seed in ten years, and even in this period of drought I never had a finer stand.

Another point is our spraying. We spray underneath the trees. The general spraying is on top; it is good as far as it goes, but it isn't enough. We want to put our sprayer underneath and spray the lower branches, and when

we do that as thoroughly as we do on top, we will have perfect fruit. Our Kings are all down on the ground; our Rhode Island Greenings are on the ground, many of the branches; and yet our spraying has been so thorough that we don't find a single scab on them when we pick them. But they must be sprayed on the under side as well as the upper side. You are right, — your good keeping apples will come from the high branches; but I believe we can combine the two, so we can get a very large per cent of very fine fruit by spraying underneath, pruning, opening the trees and letting the sun shine through, and starting cultivation as soon as we can.

Adjourned at 4 P.M.

Evening Session.

The meeting was called to order at 8 o'clock by Secretary Ellsworth, who introduced Mr. Augustus Pratt, the second vice-president of the Board, as presiding officer.

The Chair. We have had the pleasure of listening to two very interesting addresses to-day, and it gives me great pleasure to inform you of the fact that one of those lecturers who spoke to us was a graduate of our Agricultural College at Amherst. It carries my mind back many years, to 1869, when, with a number of other gentlemen, I had the pleasure of going to those college grounds as a committee from the Legislature, to see whether it was proper or policy for the State to grant the sum of $50,000 for the upbuilding of that institution. In looking back to that time, and thinking of the few buildings and the little there was there, and then seeing the great growth that has been made since, it makes me feel authorized to say to-night that we, as citizens of Massachusetts, have reason to feel proud of our Agricultural College.

This morning, as I said, we listened to an able speaker, who gave us a very interesting address, giving us facts from successes which he had made in our own State since graduating from the college. To-night it is our pleasure to have with us a gentleman who has gone abroad into another State

and made a great success, — a graduate of the Massachusetts Agricultural College. I take great pleasure in introducing Dr. W. E. Stone, president of Purdue University, whose subject will be "Education and industry."

Dr. STONE. Mr. Chairman and gentlemen: This is not my first appearance before the State Board of Agriculture of Massachusetts. I think it must have been just twenty years ago this time that I attended the meeting of this Board held at Great Barrington, in the capacity of a young man who had just graduated from college, and felt some interest in the work that was being done by the Board. Since then I have wandered far from the Bay State, but I have never lost interest in it or in any of its industries. It gives me pleasure indeed to come back at this time and to meet with the State Board of Agriculture again, and to speak to you upon the subject of "Education and industry," — a broad subject, and one which has, I trust, some application to the industry in which you are all interested.

EDUCATION AND INDUSTRY.

BY W. E. STONE, PRESIDENT OF PURDUE UNIVERSITY.

The essential basis and foundation of a nation's welfare is to be found in its industrial conditions. In asserting this truth one must not assume that national greatness consists in industrial development and prosperity, that patriotism is nourished by wealth, or that the best citizenship is a function of material progress. On the contrary, those abstract qualities which contribute to national greatness and patriotic citizenship are the offspring of ideals, rather than of material things. But these can never come to their fullest fruitage without that substantial foundation afforded by rational and well-balanced industrial forces. The highest development of national ideals is like a flower whose beauty is unfolded in the clear atmosphere, while its roots find anchorage and nourishment in the fertile stratum of an intelligent, industrial democracy.

On the other hand, the political, social and economic stability of the government does depend directly upon industrial conditions and the character of the industrial classes. No concrete example is necessary to illustrate this, but the present spectacle of Russian helplessness and disorder is a striking example to the world of conditions likely to result from neglect of this principle.

With this conception of the importance and relations of industry to national welfare, it seems appropriate to discuss before this Board, which is a representative of one of the greatest industries, some matters pertaining to present conditions and future developments in the industrial field.

In two particulars America stands conspicuous before the world to-day. First, for her industrial activity and prosperity, on a scale of which no nation has ever before

dreamed. We boast of the skill and energy of American manufacturers, of our resources, of the magnitude of our industrial enterprises; and we may truly claim for our country an extraordinary industrial supremacy. The other thing for which America is just now conspicuous is less flattering. We are far from proud of our notoriety in connection with civic corruption, insurance scandals, the beef trust, railway rebates, high finance, etc. Every patriotic American blushes for these conditions, and fears for the future of his country unless there shall speedily come to pass such a state of public sentiment and such industrial and commercial conditions as will make these things impossible.

It does not seem to me illogical to trace some connection between these two: viz., the extraordinary industrial prosperity and the remarkable development of reckless greed in great commercial and political organizations.

An analysis of industrial progress in the United States reveals this interesting fact, — that, whatever may have been due to the shrewdness and energy of our captains of industry, our remarkable industrial prosperity has largely been on account of the fact that we have been exploiting enormous natural resources in a manner which, although profitable, has in most cases been with immense waste and entire lack of foresight. Let me cite examples.

Our lumber kings have consumed the forests without regard to the past or future; simply harvesting what they did not sow or cultivate, and which cost them little or nothing, leaving the next generation to pay the cost of their profits. This might be characterized as industrial recklessness. The iron and steel industry avails itself in a monopolistic way of deposits of ore and coal remarkable for their extent and purity, and it enjoys the protection of a high tariff, amounting to a government subsidy. It thus utilizes certain natural advantages and a legal handicap against its competitors. Looked at as a matter of industrial competition with the German and English iron masters, who are compelled to use low-grade ores and costly fuel, this may be called industrial unfairness.

Not many years ago there was discovered in a group of

middle western States immense reservoirs of natural gas, — a fuel of high theoretical value and ideal qualities. With proper use it would have lasted for an indefinite time, — an industrial blessing and resource of inestimable value. It is now practically exhausted, through ignorant, wasteful methods. This might be called industrial extravagance.

We boast of our enormous agricultural products, without stopping to consider whether these are the result of a rational, conservative system of agriculture, or whether they are due to the stores of natural fertility in the soil, which we are rapidly exhausting. In actual fact, there is much in the agricultural industry which we might designate as unscientific and unwise.

The point which I seek to illustrate is, that in some part our industrial prosperity is due to the reckless, extravagant or improvident utilization of natural resources, which is temporarily profitable at the expense of future generations; and that these methods have made us rich beyond expectation, and have accustomed us to reckless and sometimes unfair industrial policies. It is perhaps too much to say that these industrial conditions are wholly responsible for the graver matters of reckless, unfair and dishonest commercial conditions; but too much and too easily begotten wealth begets in turn arrogance and greed, and these breed the men and the conditions which are shaming America in the eyes of the world.

Our industrial progress has been abnormal; it has turned our heads with the spectacle of great and easily acquired fortunes, until we are impatient of the natural course of events, and discontented with industrial conditions as they exist upon a normal plane in other countries.

How true it seems that industrial affairs not only dominate the material welfare of the people, but are reflected in their characters and traits. If industrial methods are extravagant and in violation of natural and commercial laws, then we may expect industrial leaders to become extravagant and lawless. If, on the other hand, industries are conducted scientifically and conservatively, those connected with them will be careful and conservative men.

Nor do we rightly measure the influence of industrial conditions until we take into account their great magnitude, the amount of capital employed, the number of people concerned and the value and importance of the products. While no one does or can fully grasp these facts, every intelligent person understands that they wield a tremendous influence over all other interests in the country. Associated with, and a part of, these industries, are our greatest social and commercial problems: wages, hours, labor unions, rights of employees and employers, regulation of transportation, trusts, monopolies, etc. Indeed, there is scarcely a great question before the public to-day which has not industrial relations; and certainly those problems which are most important and most difficult of solution are of industrial origin.

In this enormous aggregation of interests, capital and men, wielding such influence, in need of guidance and burdened with problems, powerful and yet weak, lies a tremendous force for the good or evil destiny of the nation. Whatever, therefore, can add to industrial efficiency by ever so little, will in the aggregate bestow immense benefit upon the race. To make two blades of grass grow in the place of one, would pay the national debt. To raise ever so slightly the standard of intelligence of millions of industrial workers, would be a tremendous contribution to the solution of the most serious social problems.

True industrial progress consists in utilizing with ever-increasing economy and accuracy natural forces and materials, in more scientific methods of operation and management, in securing better conditions of life for industrial workers, in furnishing products of better quality at lower cost, and in narrowing the gap between the employer and the employee.

None of these problems can be solved by legislation or by coercion. They obey laws which are beyond human power to change. Their solution consists in finding out the truth, and, knowing it, to follow it. True industrial progress, therefore, is dependent upon one thing, viz., education. That prosperity which comes from a profligate harvesting of nature's stores is not industrial progress, nor can it long

endure. There comes inevitably a time when the mine is empty, the forest destroyed, the virgin soil exhausted. Then will arise the real question of industrial ability, which can be met only by education and training. In like manner the vexed problems of labor and capital will be settled only by an industrial intelligence, which recognizes and accepts the fundamental truths underlying relations of employers and employed. Education alone can accomplish these ends, but it must be a new kind of education, — a kind that will reach the rank and file of industrial workers, and train them not only in the technique of their pursuits, but inspire in them respect, love and interest in their calling. That there is a field and a need for extraordinary educational effort in connection with the industries, and particularly with the industrial classes, is apparent, if we consider certain features of present industrial conditions in this country. Those I wish to speak of particularly are as follows:

First, the quality and character of the actual workers in a given industry are matters of primary importance. Upon their intelligence and mental attitude depends much relating not only to that particular industry, but the general welfare. The greater part of our people are industrial workers, actually performing manual labor of a more or less skilled kind. It is characteristic of these people to be ambitious, to seek better positions, more pay, more responsibility, and what they regard as higher social standing. Unfortunately, these aspirations are not always accompanied by that training or fitness which warrants such ambitions, although commendable enough in themselves, and made possible of gratification by the peculiar industrial conditions of America. We are proud of those American citizens who have risen from the ranks. It is the boast of our democracy that no lad is so poor or of such obscure birth but that he may enjoy at least the prospect of becoming President of the United States. The result of all this, however, is to engender a certain discontent with ordinary occupations. Where it is possible for every boy to become wealthy, famous or influential, it is plainly to be seen that he will have little or no interest in a pursuit or trade that is only obscure and

humble. Consequently, the native-born American is not to be found among industrial workers, except as a matter of necessity; he seeks no special training for such employment, because he does not expect to follow it, and will not do so longer than circumstances compel him, but will manage, by hook or by crook, to rise to what he regards as higher things, namely, a position of better social standing, if not one of really greater usefulness. The manual work of most industries is left, therefore, to the ignorant and weak or to the foreign immigrant, who is compelled to accept the employment rejected by his more astute countryman of one or two generations of Americanization.

These conditions tend to a constant degradation of industrial labor. It lacks *esprit de corps*. It is like an army continually being recruited from the ignorant and unskilled; made up of men who wish to be not privates, but officers, and who find in the ranks no abiding attraction.

The only present check to this tendency lies in the restraint imposed by the law of supply and demand, which compels men to enter the ranks, but accomplishes nothing in the way of remedying the evil. The rational correction should be an educational agency, which could train the industrial worker, and at the same time develop in him higher ideas as to the value and importance of such a station in life, and an abiding contentment in it. This is no violation of democratic principles, no plea for class distinctions; on the contrary, it means a higher kind of democracy, in which no class is stigmatized as ignorant or socially degraded.

There should be, of course, no cleavage of the American people into separate and impassable social strata, but each pursuit should be regarded as an essential and necessary part of the whole social fabric, and as an entirely worthy field for the attention of American citizens whose abilities are best adapted thereto. When we fully realize that every pursuit, however humble and simple, will be ennobled and dignified by the appropriate education and training of its members, industrial workers will become, as they should, an intelligent and substantial element in American citizenship.

Second, the mental attitude of industrial workers toward their respective callings is a significant factor in this discussion. To a casual observer it seems as if large numbers of the industrial class, particularly those in unskilled occupations, exhibit a general lack of interest in their work, or ambition to improve the quality of their service. They perform their tasks in a spiritless manner, with little feeling of responsibility, eager to hear the whistle blow and to receive their wage, but indifferent to the interests of their employers. Such conclusions as these must frequently occur to those who employ or have to deal with workmen. Every one has had his unhappy experiences with careless or incompetent persons, who expect the wages of first-class workmen, but take little thought as to the kind of service rendered in return. It seems as if many such were entirely lacking in any conception of that pride in good work, that devotion to their calling, and that dignity and self-respect, which every man should possess.

This spirit and attitude is one of the saddest features of industrial life. The explanation lies in part in what has been said about the ill-founded ambitions and tendencies of our workers to rise above their present level. It is to some extent also a manifestation of that vicious spirit which seeks the reward without the toil, and hopes for luck in the lottery of life; which desires to "get rich quick," and does not accept life's law of equivalents.

How unfortunate that multitudes whose training and ability can never lift them above the ranks of laborers must toil on through a life uncheered by pride or joy in their daily tasks, and fretted by an aimless and impossible ambition, when, under easily possible conditions, contentment and genuine satisfaction might be woven into their life work.

Our young people look askance at all manual labor or humble industrial callings, and they are unwilling to submit to the discipline necessary to prepare them for such work: although it is quite certain that large numbers of them, unfitted for anything else, must find their life pursuit in such capacities. And so the ranks of industrial workers are filled with those who either will not or cannot enter into their

work with sympathy and pride; who are incompetent, untrained, and positively a detriment to industrial progress.

How to correct this unfortunate attitude; how to instill into the minds of young people a respect for honorable toil; an honest pride in work; a desire to train for a task, to study it, to master it; how to develop in industrial workers that old-fashioned pride in their calling, and contentment to labor within its bounds, — these are questions the answer to which will be furnished only by appropriate educational influences.

The third industrial condition which is pertinent to this discussion consists in the prospective changes which all industries in this country seem destined to undergo, and which will increase the difficulties of their successful and profitable prosecution. It seems quite certain that raw materials will increase in cost and scarcity, and that sharper competition will cut down the margins of profit, so that presently many industries which have had a golden career because they were exhausting mines, destroying forests or sapping the fertility of the soil, with little competition and with unsatisfied markets, must be deprived of these advantages. Profits will then depend upon shrewdness of management, upon scientific methods, — in short, upon conditions which can only be the result of education and training. American industries must contemplate the time when their activities will include not merely a profligate harvesting of natural resources, but production and conservation as well. When this time shall come, no industry can be profitably conducted except by those who have some degree of scientific training applicable to their share in the work, whether it be great or small. This again indicates education as the chief resource in correcting or supplementing industrial needs.

In thus pointing out certain weaknesses in the industrial situation, viz., (1) the quality and character of industrial workers, (2) the mental attitude of the same, and (3) changing industrial conditions, — mention is made of those which seem likely to most affect the future of industry in America. Certainly they are of great importance, and,

with almost equal certainty, one may say they will not be corrected or met save through the working of educational forces.

Thus far I have sought to show that industrial progress was ultimately dependent upon education. It seemed important to establish this point as preliminary to some discussion of the extent and the manner in which educational agencies can help industry.

The need is evident, but how is it to be met? In suggesting some thoughts for your consideration, I propose to indicate, without criticism of existing institutions, how the facilities for industrial education, or at least education appropriate to industrial conditions, should be greatly extended.

At first thought it would appear that our excellent free public schools, supplemented by the numerous higher institutions of learning, are meeting the requirements of our people. In a sense this is quite true. Our educational system is deserving of highest praise. In no other country is popular education so free and of so high a general average as in America. It has not failed to meet the needs and the demands of a developing civilization, but it is necessary in education, as in other affairs, to progress, — to keep pace with the varying conditions of the race. Now there appears for our consideration a new field for educational effort; a need for a new kind of education, — something more democratic and popular in character than anything we have yet had. This need grows out of new industrial conditions.

A generation ago educational agencies met fairly the needs of the times in the performance of their function of preparing for citizenship. Meantime, citizenship has changed in character. Greater numbers are involved in its duties, and their occupations, which become a function of their lives, their thoughts and their citizenship, have also changed. No ignorant person can now satisfactorily fulfill these duties; and a man's education must not only involve those general matters which are fundamental, but must also include intelligent and scientific knowledge and training in his business or trade.

Our public schools, if they are to continue to prepare for

citizenship, must recognize these conditions and claims, and there must then be supplied to every industrial worker opportunity for some special training in relation to his occupation.

No industry exists which does not involve the application of scientific principles, or which is not susceptible of improvement or development, either through new discoveries or a wiser or more scientific management. This truth is fully appreciated by the Germans, whose educational policy has recognized to an unusual extent its relations to industry. Not only does it give in the public schools marked attention to the practical affairs of life, but its system of higher industrial and trade schools is unsurpassed. The fruits of industrial education in that country are so apparent as to need no comment; but it is safe to say that the fullest development of this educational plan has not yet been reached, nor do we yet realize the extent of its results. The industries of the United States, as they are called upon to meet the changing conditions already referred to, of diminishing supplies and higher costs, are bound to be at a tremendous disadvantage in the world's markets, in competition with the combined industrial and educational forces of Germany.

From any standpoint, therefore, whether as regards a more intelligent citizenship, a higher social order or a greater industrial efficiency, it is important that educational forces in the country come into closer relations to industry.

Of course we are aware that the most notable educational advance in the United States during the last generation has been the development of scientific and technological education, having in view training in the natural sciences and their application to the arts and professions; but until very recently this manifestation has been almost wholly in the higher education or college grade. This advance has been remarkable, and the aggregate of educational force now expended in this field is enormous. There are to-day in the United States a large number of institutions of college standing, devoted, wholly or in part, to technological training; and this statement takes no count of the purely scientific courses common to every institution of learning. Yet,

after all, these institutions reach comparatively few of the people. They are inaccessible to all save those who have time and money to spend, and who can make preparation for higher study. The colleges have little or no effect upon the industrial worker. They fill their place in training for superior positions; they turn out men whose influence advances the standing and promotes the progress of their respective callings, but they do nothing to train the masses who are the industrial workers. Such forces for industrial education as exist in our country are almost wholly of the higher class. The primary and secondary schools give little attention to correlating their work with the life of the industrial classes; for, although there are many manual training high schools and some few trade schools, their aggregate influence is small, they reach comparatively few, and it is easily seen that public schools as a whole hardly begin to feel the influence of the demand for a close touch with industrial needs.

The chief educational need of our country to-day is not more and greater universities and colleges for the few, but a more practical and appropriate training for the multitude in those matters which tend to exalt and vitalize industry. Perhaps one or two per cent of our young men and women enter higher institutions of learning, and even these do not come from the industrial classes. The overwhelming majority receive their entire education in the lower public schools, in which their particular environment and life work are ignored. Nevertheless, this multitude wields a large influence upon the industrial welfare of the country, and it would seem wise that the public schools, in which they find their sole educational opportunity, should give particular attention to their needs. In spite, therefore, of our superior and splendid school system and our fine technological institutes, we find that the industrial masses are practically without industrial training.

There are two phases of industrial effort, viz., the administrative and the operative. The one phase utilizes the service of few; the other employs the masses. The one calls for administrative ability and high training in all of

the matters pertaining to the industry; for mental rather than manual effort. The other utilizes manual skill, does not call for an advanced education, but recognizes intelligence and an elementary knowledge of the purposes involved. It is evident that the kind of education required to prepare men for these two phases of an industry is quite different.

We are already training men for industrial management, although not rapidly enough to meet the demand; but little or nothing is being done for the operative phases of industry, although it seems to me the need is quite as great.

The point that I desire to emphasize is, that provision should be made for instruction and training of a kind which has definite relation to, and is for the benefit of, the great mass of industrial workers. Obviously such training must be brought within the reach of the masses of the people for whom it is intended. They will not voluntarily seek it, nor can they, if they would, go far to search for it. Such training should therefore be given in all public schools, particularly in those grades upon which attendance is compulsory, since the greater number of children do not attend elsewhere. I should not like to be understood as advocating turning the public schools into trade schools, and abolishing from the curriculum any fundamental and important subject now taught there. Nevertheless, it does seem as if the public schools had in mind solely the training of a class of pupils who are expected to advance into higher grades of instruction. They seem to be getting ready, but never doing; to ignore the child who is not going into the high school and college, but must soon earn his living, and who finds neither in the school nor anywhere else encouragement or helpful training relating thereto.

Why should not the public schools be brought more closely into relation with the life of the pupils, to the end that they and their parents may feel that the training there given them has some definite connection with their life work? If in a given school nine-tenths of the pupils come from working families, why should the instruction be for the benefit of the one-tenth only; probably conforming to a uniform system in which industrial conditions are entirely

ignored? The public schools should emphasize the value and importance of training as applied to any industry or profession; they should inculcate those principles of fidelity to a task, of pride in work well done, and of ambition to make the most of all materials and agencies, which are such important traits in industrial workers. They can do this by adjusting the work and play of pupils to their environment; by correlating the reading, the arithmetic and the geography with the conditions most prominent in the lives of their patrons. Parents will then take an interest in the schools; their humble callings will be exalted in their eyes, by having some relation to learning; and a proper pride and ambition will be inspired. While the main effort of such schools should be to cultivate in the minds of their pupils a right attitude toward work and an honest pride in their respective trades and callings, there should be some actual training of the hand and eye in doing things accurately and honestly. There is nothing in this of the trade school: no narrowing specialization, but a healthy, helpful education for boys and girls who are to become industrial workers.

In referring as I have to industry, there has been constantly in my mind the greatest of all industries in America, viz., agriculture; and it is appropriate that I speak with particular reference to this industry in relation to education.

As is well known, there exists in the United States one of the most comprehensive plans for agricultural education ever undertaken, in the system of agricultural colleges established by the act of Congress of 1862. Under the provisions of this act, there are in every State and Territory colleges devoted to instruction in agriculture and the mechanic arts. In the generation which has elapsed since their establishment, these institutions have become a mighty educational force, particularly in the newer portions of the country, where in many cases they are the chief exponents of higher education. There are 63 such agricultural and mechanical colleges in the United States, having permanent funds and equipment to the value of over $72,000,000,

enjoying annual incomes of $12,000,000, and enrolling annually over 55,000 students.

Beyond a doubt these colleges are accomplishing immense things for the advancement of the agricultural industry, not alone through the courses of instruction offered, but also by means of the numerous other phases of activity, such as the experiment stations, farmers' institutes, extension work, etc. Add to this the work of the United States Department of Agriculture, almost paternal in its activity, and it is evident that no other industry enjoys so large an expenditure of money and effort in educational lines as does that of farming. Indeed, this is the most highly developed phase of industrial education in America, but in spite of this it falls far short of adequately meeting the needs.

Since these are institutions of college grade, they enroll only advanced students, and in the main their curricula deal with advanced study. The training which they offer is not elementary but rather for the administrative phase of the farming industry. But even in this respect they wholly fail in fulfilling their highest degree of usefulness. For instance, there have been graduated from these colleges 60,000 students, in round numbers. Assuming that all of these had pursued studies relating to agriculture and were all engaged in farming, this number would still supply but one specially trained man to every 100 farms in the country. If the output were 100 times as great, the industry would still not be overburdened by men trained in the scientific management and operation of farms.

But in all of this absolutely no provision is made for the industrial training of the great multitude of farmers' children, whose education is begun and ended in the rural schools. These never receive in any way any general or specific training with special reference to their homes, their environment or their life work and conditions. Yet these constitute the material from which the next generation of farmers is to come, unless, as many signs now indicate, the foreign immigrant is to take their place. In either event, the need of an elementary training is equally important, since the manual operations of farming require as much if not more intelligence and preparation than any other industry.

We may here examine a little more closely the educational needs of the agricultural industry. In no other is there so great opportunity for the applications of science, since the whole industry, still in a comparatively crude state of development, consists in utilizing well-known natural laws and forces. In no other industry are there so great possibilities for improvement in methods and practice. It is estimated that the present agricultural production of this country is capable of ten-fold increase under rational management and the maximum utilization of all resources. But it is absurd to expect these results except as the outcome of study and training in one or another way, and most emphatically by a kind of education which shall work to leaven the whole mass.

Another important condition at present is with relation to the general public attitude toward farming, already referred to in a general way. It is unfortunately true that a large class of people look upon farming as an occupation of inferior rank. If we had the caste system, undoubtedly farmers would be consigned to the lowest caste. The people who hold these views are not of such intelligence that their opinions should have large weight; nevertheless, their judgment has influence with the young people, whose loyalty to the industry is affected thereby. I have observed with interest that the most intelligent, successful and progressive professional men put a high estimate upon farming as a business, and upon the necessity for the training of those who engage in it. On the other hand, those most likely to depreciate the industry and all efforts to improve it are the farmers themselves. It is well known that the constant drift of young people is away from the farm, evidently because other occupations are more attractive to them, and this is undoubtedly due to the unfortunate popular notions about farming, based upon ignorance of its possibilities, and upon absolutely false ideas of what really constitute desirable things in life. This situation, so fundamental to the progress of the industry, is amenable only to education.

The education which is just now most needed for the farming industry is that which will touch the life and interest of the boys and girls, and will develop in them new

notions about farming. The city boy is more fortunate than the country boy, in that the idea of industrial education is gaining a footing in city schools, where manual training departments are springing up rapidly. It is noticeable that the city or town boy profits greatly by manual training, because his home experience rarely includes any training of this kind. The country boy does not need this so much, or at least he did not when I was a boy, for he gets daily practice in a great variety of manual operations, which give him skill, even though their performance is not always a source of extreme pleasure. Instead of manual training, the country school should seek to inspire in its pupils an interest in and love for rural life; to show them how all of the common farm operations have a scientific aspect; to utilize their natural interest for collecting and experimenting in the study of farm objects and phenomena; to train them to understand the value and profit of doing things correctly; and to help them to see the true beauty and interest of country life before all other. Such school training, carefully and wisely administered to our country boys and girls, would go far toward changing their prejudice against farming as an occupation; it would plant in the minds of young people the ambition to do things better, and would lead them in one way or another to seek special training for a business in which they would engage with real pleasure.

This is what is meant by teaching agriculture in the public schools, — not teaching the science of agriculture as such, but the developing in the young people a respect for and an interest in their environment, to the end that they may not desert the farms, but, remaining, develop into a new and enthusiastic race of trained farmers, who will bring to this industry interest, energy, business capacity and training, in the same measure as are considered indispensable in every other industry.

This is no fanciful scheme, but one in which far-seeing educators are already deeply interested. Industrial training in the public schools is fast being established; and that phase which relates to the rural schools and to rural life is the chief educational topic in the middle west, where country

schools are being combined and consolidated so as to secure better equipment and teachers; where instruction in topics pertaining to the farm is systematically administered, and in some instances required by law. There the industry already feels the stimulus due to this policy, and there is no doubt of the effect it is destined to work.

To the farmers of the Bay State, a State so famous for its educational wisdom and development, I can bring no more important word than to commend to your consideration this matter of education as applying to your business in larger measure than ever before, and with such broad scope that it shall include the boys and girls in the country schools. May the day soon come when farming shall be the most profitable and attractive pursuit in New England, and when farmers shall constitute an industrial class truly educated for and proud of their calling.

SECOND DAY.

The morning session was opened at 10.30 o'clock by Secretary Ellsworth, who introduced Mr. William A. Kilbourn of Lancaster as the presiding officer.

The CHAIR. It is a pleasure to preside at the meeting this morning and to meet so many of you.

I have the pleasure of introducing to you Dr. Joseph L. Hills, director of the Vermont Agricultural Experiment Station, who will speak on "Dairy precept and dairy practice."

Dr. HILLS. It is no mere lip service when I say that I am glad to come to Massachusetts. Massachusetts born, bred and educated, it seems very much like coming home when I return to the Bay State. I have learned, in my nearly twenty years of life on the shores of Lake Champlain, to love the old Green Mountain State through and through; and I hope my children as they arrive at maturity may look back upon the glorious scenery of its Champlain valley with the same heartfelt love that I feel for the environments of Boston and of the Connecticut valley around Amherst, where I was educated.

DAIRY PRECEPT AND DAIRY PRACTICE.

BY DR. JOSEPH L. HILLS, BURLINGTON, VT.

It is apt to be alleged of experiment station workers, by those who are not in sympathy with them, that their ideas are impractical, their deductions ill-adapted to every-day usage. Even the friends of the movement at times are given to the same criticism. The current issue of the Experiment Station Record, the monthly publication of the United States Department of Agriculture, which reviews the agricultural science work of the world, voices this proposition in the opening sentences of its leading editorial, as follows: —

The statement is made that scientists often retard the progress of general and industrial science by their impractical views of practical affairs. The idea is not that investigation should be confined to utilitarian lines, . . . but . . . that . . . more rapid and surer progress would be made if investigators brought to their work more practical knowledge of its economic relations.

It further remarks that: —

A large body of people continue to distinguish between what to them is theoretical or pure science, and what is applied science. To such, Doctor Jordan's estimate of the value of science, that it "lies in its relation to human conduct," and of the value of knowledge that it "lies in the use we can make of it," will come as a vindication of a possibly unformulated conviction.

In other words, there is a popular demand for fruitage from the tree of knowledge. Now, as of old, to secure and to retain popular favor and public funds, scientific work must be "disguised [to some extent] under a utilitarian

cloak." It must and ought to yield results helpful in the solution of economic problems.

One of the speakers at the recent convention of the Association of American Agricultural Colleges and Experiment Stations stated that, so far as their relationship to the experiment station movement was concerned, farmers might be classified in three groups: those who had no faith in it, those who had unbounded faith in it, and those who knew nothing at all about it. The attitude of each of these groups constitutes a menace to the enterprise of scientific investigation in agriculture. Those who have no faith are hostile, of course; those who still in this year of our Lord are uninformed of the existence and activities of so widespread and beneficent a movement — and there are more of them than we realize — as a rule recruit the ranks of the unbelievers as fast as they "get wise"; while the friends of the application of science to the practical affairs of life are apt to embarrass its votaries by over-large expectations, and, being disappointed, often become disillusioned if not disgruntled. There is much wisdom in the advice of the darky philosopher which says that "Blessed am dey what don't expect much, 'cos dey don't get disappointed." They find, or think they find, that the theory does not work out in fact; that the scientific exposition does not justify itself when put to the test of every-day usage; that the preachment of the ideal cannot be met in the performance of the practical; that, in short, practice falls so far short of precept as to be but little guided thereby. Is this mental attitude a sane one? Does the agricultural investigator overshoot the mark? Are his laboratory-born dictums unapplicable in every-day affairs? Yes, and No. There are dangers in both directions. On the one hand is the investigator who neither clearly sees the practical bearings of his work nor knows how to apply it; and on the other hand is he who jumps at conclusions, who looks only for the practical application to the detriment of thorough work. The one has his head in the clouds; the other, in the soil. The one fashions air castles sometimes, but he often lays foundations; the other builds his house upon the sands.

It is held by some that the investigator should formulate his precepts as ideals, leaving to the practitioner their adaptation to his individual circumstances. It is held by others that it is not beneath the dignity even of the votary of pure science to accord weight to practicalities. Personally I have always trained in the latter camp, and so I have less hesitation than others might have in trying this morning to reduce, as it were, to their lowest terms some of the formulations of agricultural experimentation; to state first the precept and then its practical application, confining myself for illustrations to dairy practice.

The Century Dictionary defines a "precept" to be "a direction given as a rule of action;" and it tells us that practice is "performance or execution, as opposed to speculation or theory." Let us now cite several of these "directions as to rules of action," and then compare therewith their "performance or execution."

The Dairy Cow.

First, as to the cow. Dairy precept says: The average cow yields so little milk or butter as hardly to pay for her keep. Therefore, breed better, feed better, choose and cull better, grade up the herd. Make 6,500 pounds of milk and 300 pounds of butter per cow an "irreducible minimum." This is sound doctrine; but what does practice say as to its entire applicability?

An editorial in a recent issue of a New England agricultural paper says, in this connection: —

We are out of patience at the way scientific workers approach this vitally important question of the pressing need of more good cows in our dairy herds, and at the way that they leave it to be understood they have given an easy solution. Dairymen know as well as they do that there are poor cows in their herds, . . . and they would gladly exchange them for better. The stock instructions given are to clean out these "robber cows," and replace them by better. Do these . . . teachers . . . realize what those directions . . . actually mean when . . . put into actual farm practice? The individual doing it may be helped, but there are no more good cows than before the change was made. What has been gained by the sharper man

. . . is . . . lost by the other fellow. . . . There are not superior cows enough in existence to meet the wants of all who realize the advantage coming from their possession.

The editorial then goes on to say that the exhortation to breed from a registered bull is not a panacea; that few sires beget offspring materially better than the cows with which they are mated; and that the breeding of superior animals is a complicated problem of uncertain outcome.

Now is there not some middle ground? The average Massachusetts cow gives 516 gallons of milk, or but 67 per cent of the precept standard of 765 gallons (6,500 pounds). There are many giving more than this, and, obviously, many giving less. It is so simple a thing for a dairyman to determine the milk yield of each cow: the time element is so negligible, the apparatus so simple, the operation so kindergartenish and the information afforded so illuminating that it is incredible that so few carry it out. Spring balances with pointer so set that the empty pail brings it to the zero mark, a ruled sheet of paper and a pencil constitute the apparatus; hanging the full pail on the scale, noting, recording, footing up of the totals constitute the operation. That is all.

Even this relatively small amount of work may be reduced to but one-tenth its volume without seriously affecting the validity of the results. If one weighs the milk of each cow during any three days in each month, say, for instance, the 15th, 16th and 17th, or the 10th, 20th and 30th, and then puts a zero at the end of the additions, the result will be close enough to the weights which would have been obtained during the entire year had weights been made daily; that is to say, close enough to enable one to detect the unprofitable animals. Of course one naturally takes cognizance of a shortened month, if the animal comes in or goes dry during the month. This statement as to the validity of the data thus obtained is based on a thorough survey of the immense mass of data at hand, obtained during seventeen years at the Vermont station with a herd of from 12 to 70 cows.

What does it mean in terms of time? Twenty cows, in milk on the average say ten months in the year, 20×6

$\times$ 10 = 1,200 weights of milk in the course of the year. Separately to weigh and to record the weight of the milk of each cow, if the scales are conveniently placed, can hardly take at the outside more than half a minute's extra time per cow. It takes us much less time than this. This totals six hundred minutes, or one working day of ten hours for one man; and as a result of that day's work one gains a close knowledge as to the efficiency of his several cow machines. Scales cost about $3, paper and pencil 3 cents. Is not such information worth so slight an expenditure?

Testing milk is more of a proposition than is weighing milk. It involves the use of a Babcock tester. It implies some little knowledge as to proper methods of sampling and testing. Here, again, the time and effort needed to this end may be minimized to the last degree by making careful choice as to the time of sampling and by co-operative testing. A most thorough survey of the mountain of data hitherto referred to, obtained with our station herd, which is under constant observation both as to the weight of milk and its test, enables me to say with entire assurance that, if properly taken composite samples are analyzed twice a year, essentially accurate results are attained. If a sample is taken when the cow is one or two months along in lactation, and another when she is five or seven months along in lactation (the five-months period being safer for cows which go dry early), the average results of the analyses of the two will nine times in ten be quite close to those which are obtained when samples are frequently taken. In other words, sampling and analyzing twice a year, if samples are properly taken at proper times, usually afford essentially accurate results.

Sampling the milk of a herd of 20 cows in this manner may consume a total of four hours' time. The analyses may be made by the dairyman himself if he cares to, as the process is neither expensive nor difficult, although careful attention is needed; or they may be made by the creamery butter-maker for a small sum; or some young man or woman in the community may own a Babcock, and do this work at a financial profit to himself or herself, and to the

advantage of the dairymen; or, in exceptional circumstances, the experiment station at Amherst may handle the samples. With, then, weights of milk and tests of milk in hand, the simplest mathematics will indicate the relative standing of the various animals; and, more important, whether or not any are failing to make adequate return for the investment in food, care, etc.

It needs to be remarked, however, that a single year's trial is not always to be depended upon. There may be reasons for an otherwise good animal doing poorly in some given year. In other words, the information thus obtained needs to be interpreted with judgment.

These procedures are not difficult to put into effect; and they do this much, — they give, within limits, a fair notion as to the dairy worthiness or worthlessness of the sundry animals. Granted that, as our editorial friend claims, there may not be "superior cows enough in existence to meet the wants of all who realize the advantage coming from their possession," — is that a justification of the harboring of cows whose milk yields do not sell for as much as their food costs? If some Anna Eva Fay could pass through a herd and unerringly point out the unprofitable animals, and if the owner were convinced of the infallibility of her verdict, would he not cull out such cows at once? So should he when weight and test point out the "cow boarder."

The results of a cow census carried out with 100 herds in Vermont this past year is suggestive in this connection. These herds were located in three different counties. Thirty-eight of the herds were Jersey grades; 2 were grade Holsteins; 4 grade Ayrshires; 1 was a Guernsey herd; 1 a Normandy; in 1 Ayrshires and Guernseys predominated; in 1 other Ayrshires and Holsteins; in 3 others Jersey and Holstein or Jersey and Ayrshire, probably grades in most cases; and the rest were mixed lots. The herds ranged in size from 5 to 70 and averaged about 20 cows. The estimated cost for food of keeping a cow varied from $32.90 to $41. The average income per cow ranged in the several herds from $15.82 to $63.57; the pounds of butter sold per cow from 84 to 315 pounds; the price received for

the butter fat from 19.7 to 26.7 cents. The creamery money returns for $1 spent for feed varied from 42 cents to $1.57. The profit and loss account, for the several herds, varied all the way from a gain of $22.57 per cow to a loss of $21.68 per cow. In other words, the average cow of one herd made $22.57 worth more butter than her food cost, while the average cow of another herd made $21.68 less than her food cost. Thirty-two of the 100 herds made a profit over and above the cost of food, and 68 failed to do so. And this in the dairy State of Vermont! The average production of butter per cow was about 175 pounds, which is above rather than below the average. The average milk production is not stated, but it must have been in the close vicinity of 4,000 pounds.

The publication of this data raised a riot in our State. It was freely asserted that the name of the party who carried out the investigation had been slightly mispronounced. His name was Lyon. Such survey as I have been able to make of the data leads me to believe that the cost of feeding is if anything overestimated. The hay, for instance, is rated at full sales price, $12 a ton. And yet this cost, an average of about $37, is very much below the amount which it costs us at the Vermont station to feed our cows. But it is, however, the comparative rather than the absolute figures which are of interest; and, however much one may pick flaws in some of the details, the main proposition is clear, — that in a very considerable share of these cases so low a money return was received at the creamery as to make the enterprise at best a doubtful one. The relationship of improved blood to the result is of interest. The cows in nearly half the herd were said to be grades or mixed. Yet these figure in but one-third the cases where a profit was returned. Or, phrasing it in another way, in 60 per cent of the herds where material profit over food cost was gained either Jersey or Guernsey blood was present in sufficient quantity to be a dominant factor, though they made up but 40 per cent of the total number. Of course an investigation of this kind is faulty, in that it takes no cognizance of the worth of the skim milk; of the manurial values of the feeds brought onto

the farm, or of the fodders fed upon it; of the relation thereof to the maintenance of farm fertility; of sales of fat cows; of the raising and selling of calves, etc. However, the point I am trying to make here is not as to the exactness of these figures, or of all the deductions which may be drawn therefrom: it is the development of the fact as to the existence in these herds of large numbers of unprofitable animals which is important, and which an investigation of this kind ought to incite their owners to remove. If No. 62, milking 70 grades at a food cost of $40, with a butter return of over $60 per cow, or a cash return for each dollar spent of $1.55, — if No. 62 can do this, his example ought to be an incentive to his neighbors, and his methods, so far as may be, copied. And, per contra, No. 92, whose 27 grade Jerseys cost him $36.50 apiece to feed, yet returned him but 110 pounds of butter apiece worth $21.20, or but 60 cents income for each dollar of outgo invested in feed, — No. 92 ought to put on a thinking cap, and consider where he is "at."

To weigh, test and calculate; to compare with cost of keeping; to cull. These are relatively simple and fairly certain procedures, but the rest is not as easy to accomplish. One can kill a cow in a moment; but to get a better one in her place means time, money, special skill, rare judgment, many failures and disappointments, and slow progress. Destructive processes are always simpler than are constructive ones.

The usual advice as to the use of a registered bull is more commonly heeded to-day than hitherto; but the results are more apt to be disappointing than the reverse. Registration is far from being certification. It has been aptly said, "There is no scrub so poor as the pure-bred scrub." The proportion of blanks in breeding is very large; and unfortunately one cannot always tell blanks from prizes with certainty until after three or four years of bovine life have elapsed. For example, we have had at the head of the present experiment station herd at Burlington during the past ten years three different registered bulls. Each of these animals was stated to be among the best get of three famous

herds. Their pedigrees in each case showed many fine lines of breeding; and yet, as used on the registered and grade Jerseys at the station farm, — animals which made on the average for a dozen years 324 pounds of butter, — the proportion of heifer calves which on raising have proven satisfactory as judged by our standards has been far less than 50 per cent. The selection of the sire, which is to be half of the coming herd, and the breeding of superior heifers are no easy tasks. And yet naught better can be suggested than to make such choice of the head of the herd as seems wisest; and to that end I deem it practicable that those who seek such an animal, as well as those who wish better to know a good cow when they see her, study thoroughly the matter of relationship of type to performance; that they should learn to judge cattle, and to appreciate the meaning of the "points" of the score card; that they should familiarize themselves with such admirably adequate yet simple directions, touching the correlation of form and function, as are furnished free to the dairy world in Director Soule's treatise on the conformation of beef and dairy cattle;[1] and that they should make use of their apprehension of these assembled concrete expressions of experience in the selection, the purchase and the breeding of cows. He who is thus fortified is apt to make fewer mistakes than does he who has not this special knowledge. To be sure, successful animal husbandrymen are apt to be born rather than made; yet their judgments may be thus matured and standardized.

Yet when all is said, "Handsome is that handsome does;" and actual performance at the milk pail is of more avail than are ideal contours, tortuous milk veins or a prominent pelvic arch. A few observations made at the Vermont station have pertinence here, as illustrative of this point. Our cows are under constant observation. We have records extending over ten years of lactation in several cases. These cows were carefully "judged" according to the "scale of points" of the Jersey Cattle Club by a party who was fairly well skilled in judging, and who did not know how good or how poor dairy animals they were. He similarly

---

[1] United States Department of Agriculture, Farmers' Bulletin No. 143.

surveyed two registered Ayrshire herds which for years had been under careful observation by the station as to milk and butter yields, using, of course, the Ayrshire score card. The outcome was essentially as follows: 30 mature cows, scoring 90 or above, gave 6,478 pounds of milk and 321 pounds of butter; 20 mature cows, scoring 88 or 89, gave 6,263 pounds of milk and 325 pounds of butter; 12 mature cows, scoring 80 to 87, gave 5,699 pounds of milk and 286 pounds of butter.

Again, the relationship of udder conformation — be it well-balanced, ill-balanced, funnel-shaped, deficient in any respect — to the milk and butter yield was similarly studied by one of our senior students, using the station herd, with results as follows: Thirty-four cows were surveyed, and their records for from one to eight years averaged. Five, with finely balanced udders, averaged 5,725 pounds of milk; 18, with fairly well-balanced glands, 5,377 pounds; and 11, with ill-balanced udders, 5,219 pounds of milk. The butter yields were 342, 333 and 324 pounds respectively. Four out of 5 cows with well-balanced udders made more butter than did the average of the 18 which had but fairly well-balanced udders, or the 11 with poorly balanced glands. They also made more than the average of the herd for twelve years, — 324 pounds. Per contra, 8 out of the 11 cows with poorly balanced udders made less butter than did the average of the 5 who were thus well built, or the 18 whose glands were fairly well formed; and their records were all, moreover, below the twelve-year herd average of 324 pounds.

These determinations were made with cows far above the average in productive capacity. It seems fair to assume that, had inferior or average cows been under survey, the results would have been even more pronounced. But it all goes to show that the up-grading of a herd by breeding is likely to be a slow process. If intelligence is used, however, the progress taken in the gross, though slow, is likely to be fairly certain, provided that cross-breeding is not practised. This procedure generally results less favorably than does mating within breeds.

Feeding.

The feeding proposition is a less difficult one to encompass, the results of experimental trial are more quickly apparent, and errors of judgment are less costly. Many cows give inadequate milk flows because they are of beef build, placing the food as their ancestry has willed it, — on their ribs instead of in the pail. Others, on the contrary, have failed simply because they have not had a chance; they have been inadequately fed. Here may be cited the classic experiment of the Kansas Experiment Station, published in its Bulletin No. 86.

The station authorities bought 30 scrub cows, which it is stated appeared on the whole to be inferior in quality to the average herds of the State. These were fed for an entire year on rations rich in protein, designed to stimulate the milk flow. The main roughage used was alfalfa hay, fed during the months of barn feeding in as large quantities as the cows would take. During the out-of-door life they had pasture with green kaffir corn for soiling. The grain feeds used were mainly wheat bran, linseed meal, kaffir corn and corn meal, about 8 pounds daily in the barn and 3 pounds while at pasture. These cows averaged for the year 5,700 pounds of milk and over 275 pounds of butter. The best one yielded 9,100 pounds and the poorest 3,600 pounds of milk; the best one nearly 450 pounds of butter and the poorest nearly 160 pounds.

The Kansas station authorities collected the records of 82 herds in one of the leading dairy sections, and found that the average annual yield per cow was 3,441 pounds of milk, or 150 pounds less than that of their poorest but well-fed scrub cow: that the average yield of butter was 122 pounds, or 36 pounds less than that of their poorest cow. The average return for butter at the creameries was $19.79 per cow, or $1.60 less than the returns obtained from their poorest but well-fed scrub cow, and but little more than half as much as was returned by the average of the entire herd. The station authorities attributed their success with their scrub herd to three causes: —

First. — To the fact that at all times the rations given were either balanced or contained an excess of protein, whereas the average Kansas cow on dry feed usually got but half enough protein.

Second. — To kindness and adequate shelter.

Third. — To the maintenance of a full milk yield throughout the summer drought, secured by extra feeding.

I have lingered long on this phase of the subject, and have only emphasized old ideas; but the better cow is so badly needed, and some of these means of more nearly attaining her upon every farm, and particularly the practicability of setting some of these means in motion, are so ill-appreciated, that in season and out of season, in class room, institute meeting and at large gatherings such as this, whenever dairying matters are in hand, I label this proposition, moldy old chestnut that it is, "Exhibit A," and talk and talk and talk about it. Let us do, as well as talk. We can, if we will, get ahead in this matter, slowly, to be sure, but yet ahead. Keep thinking about it; and then do something.

The Protein Content of the Ration.

A generation or so ago precept stated that 2.5 pounds of digestible protein daily was needed by a 1,000-pound cow in full flow of milk; that a balanced ration was a definite and arbitrary thing; and that he who fed less protein than this was unwise. Practice, however, has not accepted this dogma without question; and, moreover, further investigation has served materially to modify its interpretation. The old German feeding standards are now taken to be guides rather than rules; as suggestions rather than as assertions. It is realized that they are made of india rubber, and not of cast iron. Protein is not made so much of as of old; it is no longer a fetish. Its paramouncy is still admitted, but less stress is laid upon the needs of definite amounts. Haecker's fine dairy cows, mature animals in good milking form, yielding well, though they have never eaten as much as 2 pounds of protein a day, are living exponents of doubt. The forthcoming report of the Vermont station will contain a summary of seven years' study of this matter, using nearly

350 cows. The mere paper which carries the closely written data weighs over 30 pounds, and the separate items of the records run far into the hundreds of thousands. A careful study of the condensation of this data impells me to believe that, if immediate returns of milk and butter are made the measures of value, rations with nutritive ratios as wide as 1 : 6.5 or yet wider are apt to prove economically as serviceable as those which more nearly approximate the German standards. When one considers the continued dairy well-being of the cow, the maintenance of her ability to keep her flow at a maximum for a series of years, the getting a heifer early in her cow life up to standard, — all of which are conditions that are promoted by liberal feeding, — a somewhat narrower ration than 1 : 6.5 is perhaps advisable.

When, moreover, the manurial values of purchased feeds are taken into account, another handful or two more of cotton-seed or distillers' grains may be advantageously used. It is a local question, — a matter for each feeder to settle for himself. On the whole, I like protein for myself and for our cows.

Nowadays precept urges alfalfa as a source of protein in dairy feeding in the east, and practice is taking up the proposition with some avidity. Here is another case where the precept is theoretically correct. As a matter of fact, however, alfalfa has not often proved to be a permanent success in New England. A somewhat thorough survey of that territory, made a year ago by the United States Department of Agriculture and the Vermont station in co-operation, served to narrow New England's permanent success with alfalfa to a single locality, the Champlain valley, where soil conditions favor its growth. That it will never do well elsewhere in New England is too bold a statement for one to make; but that the likelihood of success in the near future is great can be denied with safety. This ought not, however, to discourage ambitious dairymen from trying the crop in a small way. One is apt to get a fair return, even though permanent success is not met; and one learns by failures as well as by successes. If the soil is well drained, of limestone origin or thoroughly limed if not, fairly weed-

free (especially free of witch grass), if it does not heave in winter, if well enriched, if one is willing to fuss with and baby the crop at the outset, to experiment with it and to keep at it year after year with careful observation, the chances of the crop are bettered, but success will not be insured.

Dairy Sanitation and Cleanliness.

Precept waxes eloquent over matters of dairy cleanliness and dairy sanitation. Rules galore are laid down for the improvement of stable conditions and for the reduction of the bacterial content of the milk; rules which, carried out in their entirety, are absolutely prohibitive; rules which are seemingly simple, but actually more or less impracticable in view of the low prices at which milk is sold. Are there not, however, measures which are at once simple, scientific and sensible, which are practicable, not too costly, and withal effective, whereby stable sanitation and cleanliness may be enhanced and the quality of the milk bettered? If so, dairymen will be more likely to adopt the suggestions, and to appreciate how close is the relationship which exists between dirt and dollars.

The following procedures, already established on many farms, may well be engrafted on common dairy practice, and without involving excessive outlay of money or labor: —

1. The cow stable may be whitewashed.
2. The sunlight may be let in freely.
3. The cows may be well bedded.
4. Plaster or acid phosphate may be used in the gutters.
5. Manure may be frequently removed.
6. An adequate ventilation system may be installed.
7. A form of tie-up may be used which will tend automatically to keep the cow relatively clean.
8. A sanitary milk pail may be used.
9. Special clothes may be worn at milking.
10. The udder, flanks and abdomen may be brushed before milking.
11. The fore milk — the first three or four streams from each teat — may be rejected.
12. The milk may be promptly removed from the barn,

and aerated, cooled or separated at once, according to the use to which it is to be put.

Are these suggestions impracticable or impossible? Let us review them briefly as to their advisability and their probable cost: —

1. A coat of whitewash in the stable is a dirt discloser; in a small degree an antiseptic; a brightener of the stable. The United States Lighthouse Boards' formula, applied with a spray pump, is said to be a quick and effective means to this end.

2. Sunlight in the stable is nature's great germicide, and one of the most effective means of lessening the multiplication of germ life; a dirt discloser; health-giving and grateful to the cows. Shutters will keep in the warmth on winter nights.

3. Bedding is worth all it costs and more too, in added comfort, added milk, and in the prevention of manurial wastes.

4. Plaster or acid phosphate in the gutters is an air-purifier, ammonia-absorber, manure-enricher, money-maker, worth ordinarily more than they cost as fertilizers, and in no wise injured for such service by use in the stable.

5. Prompt removal of manure is generally recognized to-day as the wisest procedure, viewed solely from the plant food stand-point; one which conduces also to the betterment of the milk.

6. Barn ventilation is apt to be the most costly, and often the least satisfactory, of the dozen suggestions to put into operation, since every barn seems to be more or less a law unto itself as to ventilation.

7. There are several self-cleaning tie-ups, if we may believe the statements of inventors. The one which I recently heard advocated by Hon. B. W. McKeen, late secretary of the Maine State Board of Agriculture, strikes me favorably. In brief, it consists of a platform so short and a feeding rack for hay so placed that when standing the animal is practically forced to place her hind feet in the trench, and when recumbent to lie with her head close to the front and her body entirely out of the gutter and of its contents. The

trench is deep enough to make the cow uncomfortable if she tries to lie with her flank therein. It is stated that this simple device practically solves this question.

Before we pass on in our brief review of these dozen suggestions, from the 7 which have to do with stable construction and management to the 5 which deal with the care of the milk, let me say in general, touching the care of milk, that it is now well understood : —

(*a*) That most of the ills which befall milk are of bacterial origin ; that (*b*) practically all the bacteria get into the milk after it leaves the udder; that (*c*) bacteria may be combatted in three ways : (1) they may be kept out of the milk ; (2) they may be killed when in the milk ; (3) their growth therein may be checked.

Exclusion, destruction, restriction : exclusion through cleanliness ; destruction by heat or chemicals ; restriction by cold. The cheapest way to accomplish the desired end is doubtless to kill with chemicals ; but fortunately the "embalming" — as it has been aptly termed — of milk is now an offence against man's laws, as it has always been against God's laws. Refrigeration and pasteurization are both effective, and so may be the simple, every-day cleanliness with which the 5 final suggestions have to do. Let me rehearse them again : —

8. The use of sanitary milk pails.
9. The use of milking clothes.
10. Brushing off the cow before milking.
11. The rejection of the fore milk.
12. The prompt removal and handling of the milk.

8. The ordinary milk pail is at fault in two particulars, as to its top and to its bottom, both of which are open and ought to be closed, the one against the inlet of dirt, dandruff, hairs, flecks of dry excreta, bacteria, etc. ; the other against the inflow of the milk itself. The sanitary pail is so important and so effective a mechanism, and yet withal so simple and so cheap a device, that I may be forgiven for laying some little stress upon it. The several forms differ from the ordinary pail in being partly or wholly closed at the top, and in having either no seam at the juncture of

bottom and side, or one completely filled with solder. The three more common forms are the Gurler, the Stadtmüller and the hooded pails. The first two are much alike in that the streams from the teats fall upon surfaces of cheese cloth and absorbent cotton, held by metal collars in a frame which covers the pail top. The milk is strained into instead of out of the pail, and little or no impurity can pass so effective a strainer. The hooded pail differs from the ordinary simply in that a metal hood covers most of the top. It is so held during milking that very little can fall in from the cow's body, yet the milking proceeds as usual. At first sight every milker raises the objection to all these pails that they are impracticable, that the opening is too small, etc. Yet the fact — stubborn things are facts — that they have been in successful use for many years in many dairies, and that after a day or two's practice they are as readily used as is the ordinary pail, shows that this notion is grounded in prejudice. The cost of the hooded pail is but little more than that of the ordinary pail, while the cost of the covered pail is perhaps twice that of the ordinary pail. The bacterial content of the milk drawn into a covered pail as compared with the same milk drawn into the ordinary pail is very small, and its suspended dirt is *nil*. No argument need be advanced as to the desirability of doing away with seams in the milk pail; therein milk residues normally lurk, no matter how thoroughly cleansed the pail may have been, which make the seams breeding-places for bacteria.

9. It is not much of a chore to slip on a cleanly white suit before milking; it is, however, quite a task to keep them cleanly by frequent washings. No small part of the bacterial infection of milk is derived from the person and clothes of the milker.

10. A large share of the palpable dirt of milk falls into the pail during milking. A few seconds spent in dusting off the cow, as it were, minimizes this greatly, and does no conceivable harm. A damp cloth is to be preferred for this purpose.

11. The first few streams from each teat contain very little fat but very many bacteria. They work their way up

the channel of the teat from without, and find therein ideal conditions for rapid multiplication. If these are milked onto the floor the gross yield will be slightly lessened, but the purity of the milk, so far as germ life is concerned, is vastly enhanced.

12. The desirability of this proposition is so well understood that no words need be wasted thereon.

Granting, for the while, that these procedures are effective, one may justly ask three questions: —

1. Are they not singly or collectively costly in money and labor?

2. What return may be expected for the outlay involved in their adoption?

3. Are they worth while?

1. Whitewash, window glass, straw or other bedding material and land plaster cost money; the frequent removal of manure, the installation of a system of ventilation and the changing of the tie-ups mean labor and expense; the use of sanitary pails and clean clothes will cost something; the brushing off of the cows, the rejection of the fore milk and prompt removal of the milk, however, cost but little. It is obviously impossible to say how much these will cost, but their total will amount to a considerable sum.

2. Under present conditions and in most cases the money returns are not likely to be commensurate with the outlay of thought, effort and cash, if all of these procedures are put into practice. That this is so is greatly to be regretted. Boston contractors and creamery managements do not as yet grade milk as to its bacterial content. Dirty milk, if not too dirty, sells for as much as does clean milk. It is only when one has or can gain access to a special market, or when one is selling his own products on their own merits to discriminating consumers, that it pays in cash to exert much special effort to make an extra clean milk.

3. Is it worth while to follow precept in this respect? I believe it is. The words "worth while" are not synonymous with the word "dollar." The adoption of some of these dozen rules will do so much good at not too large outlay that it is worth while from the standpoint of self-satis-

faction, if nothing more. It is better to lead than to follow; to set the pace than to lag behind. To make milk thus in many communities is to invite the unkindly criticism and sarcastic comment of one's neighbors, to inspire jealousies; but in time the example tells, the light lighteneth the Gentiles, and the general situation is bettered. Then, too, legislative enactment and municipal regulation are taking cognizance of the relation between dirt and disease, the coli and the colic, the bacterial content of the milk and its keeping qualities; and are making requirements touching this matter as they have before done as to food values. It is safe to predict that before long cleaner milk must be made for Boston and Worcester than is now made, — another reason why it is worth while thinking about how, at minimum outlay, a maximum cleanliness may be attained. Finally, before dismissing this phase of the subject, let me remark parenthetically that dirty milk kept cold excels in keeping qualities clean milk kept warm. Clean cold milk is the acme of modern milk-making.

The creameries in the western part of the State, like those in Vermont, experience difficulties in connection with the cream deliveries. Precept, that is to say, dairy experimentation, warns the butter-maker that he cannot make high-grade goods from a sour and infrequently delivered cream. It tells him that, if forced by circumstances to receive such cream, pasteurization and special cultures may better it. And it further states that, when he comes to test such cream for the purposes of dividend-making, he must weigh the pipette delivery, lest he make gross errors. What answers practice to these say-so's? It admits the contention that sour cream deliveries are to be deplored, but states that the small size of the herds make it impracticable to gather or to deliver it daily; and it states that despite instruction, pleading and invective, the relatively simple and inexpensive means for keeping the cream sweet are often ignored by a few, to the detriment of the entire make.

It further says that when circumstances — an all-covering word, like charity — compel the making of such material into butter, precept is right in suggesting pasteurization and

special cultures; that, in other words, such a procedure, while costly, is a practicable one. The pasteurization process (so called; it is not such in the strict usage of the term, but is in a commercial sense) does not rid the sour cream of the products of the fermentation, but it does destroy the bulk of the organisms which brought about the fermentation; then the heavy seeding of overwhelming numbers of the specific micro-organisms of a pure culture and their multiplication under favorable conditions serves to cover up the taints, and to make — if not the best — at least an article of good grade.

Practice, speaking in the butter-maker's voice, has looked askance for some time at precept's commandment, Thou shalt not test cream by measure. It has been averse to adopting the scales to weigh out the necessary 18 grams of cream. An increasing proportion of creamery managements up our way are using them, but more are, I fear, ignoring them, as well as shutting their eyes to the extra surplus due to cream patrons. Practice needs a severe jolt right here; and it behooves creamery patrons whose raw material is bought as cream to see to it that justice is done them; that (1) adequate and accurate samples are taken; that (2) accurate analyses are made, which can only be accomplished if the cream carries 25 per cent or more fat, or is at all sour, by weighing 18 grams into the test bottle; that (3) an extra surplus, approximating 3 per cent increase over that accorded to milk patrons, is allowed them.

And now, finally, as to dairy education in general. Precept says: "Knowledge is power;" "Prove all things; hold fast to that which is good;" "Be not hearers only, but doers of the word." And on its part practice has been revolutionized within a generation, and largely as a result of dairy investigational work. One has but to compare the methods of butter and cheese making and of the handling of market milk of 1875 and of 1905 to note the vast changes which they have undergone. If these changes be traced back, a large share will be found to have had their genesis in scientific investigation. To barely mention some of the classic contributions of American research to this end: —

The Babcock test, which placed co-operative dairying on a business basis (Wisconsin station).

The cheese investigations of the New York station, touching all phases of the industry, throwing a flood of light into many dark places.

The bacteriological studies of the Connecticut, Michigan and Wisconsin stations, which have disclosed much as to the relationship of micro-organisms to milk diseases.

The studies as to the origin of milk fat and of the relationship of food to fat yield and percentages, carried out by the New York and Wisconsin stations.

The investigations as to the market milk proposition of the United States Department of Agriculture and the New Jersey station.

The respiration calorimeter work at the Pennsylvania station, whereby the attainment of a more accurate idea of food values than has hitherto obtained seems likely.

The demonstration of the Illinois station as to cleanly milk-making, culminating in a dinner served in a cow stable.

The feeding trials of a dozen stations, which have served to indicate relative values.

Again, it is instructive to compare the dairy literature of a generation ago, or of half a generation ago, with that of to-day; to read the records of proceedings of meetings like this, and note the difference in the trend of thought. I cannot express myself better than in the words of Prof. T. C. Chamberlin of the University of Chicago at the semi-centennial jubilee of the University of Wisconsin. This gentleman, in discussing the change in the popular attitude towards agricultural questions in that State resulting from the research and extension work carried on there by the university, said: —

It was my privilege to compare the agricultural conventions of this State at two periods separated by a decade, within which the experiment station became a potent influence. The dominant intellectual and moral attitude of the earlier period was distinctly disputatious and dogmatic. Opinions and floating notions played the part that should have been reserved for demonstrations; interpretations were loose and close analysis

rare. In the second period the dominant attitude was that of a scientific conference. Opinions were replaced by demonstrations or by tentative hypotheses; conviction was sought by the presentation of determinate facts, gathered by experiment and laborious observation, carefully analyzed and cautiously interpreted; the whole was characterized by a notable approach to the methods of approved scientific procedure. The intellectual and moral contrast of the two periods was one of the most pronounced expressions of advance in the higher education in a great mass of people in the midst of practical life which it has ever been my privilege to witness.

Dairy precept has often pointed out a road of so steep a gradient that dairy practice could not travel it. Yet this were better than to indicate only a dead level. The upbuilding of an industry, which totals in 1905 in this country the vast sum of $665,000,000, second only to the corn crop in value, leading hay, cotton, wheat and poultry by considerable margins, with all other crops distanced, — the upbuilding of such an industry is a great work. Dairy practice has done well, and much of its well doing it owes to dairy precept. Let us at this Thanksgiving season be grateful that it has been given us to see and in a small way to take part in the advancement of so vast an industry.

QUESTION. Are sanitary milking pails a good thing?

DR. HILLS. The sanitary milking pail of the covered type is essentially a stamped tin pail which is covered over. Quite a large portion of the total area of the top is open, and a collar slips inside the opening. One simply takes the collar out, puts in a layer of cheese cloth, a layer of ordinary absorbent cotton and another of cheese cloth, and then replaces the collar. Thus you strain the milk into the pail through the finest and best medium known to man. A good many people at first sight think these pails impracticable, but they are used very largely now, and wherever used have been found entirely practicable, and not to materially increase the time of milking. It costs about a quarter of a cent a milking for a herd of 20 cows to supply the absorbent cotton and cheese cloth.

QUESTION. Doesn't the pail contain something more than an ordinary collar with the absorbent cotton and strainer? Isn't there a wire in the strainer at the bottom of it?

Dr. HILLS. There is. I omitted inadvertently referring to this fact.

Mr. HENRY FIELDEN (of Beverly). I am superintendent of probably the largest herd of cattle which sends milk to the city of Boston, and we have used and do use the sanitary milk pail altogether. We have fifteen or sixteen men milking. I believe that a pail with a seam at the bottom is not a pail to use. The block tin sanitary pail is covered entirely on the top, with the exception of a space about seven inches wide. Into this is fitted a collar, on the bottom of which is a very fine wire gauze strainer similar to the gauze in the bottom of all strainers. We place inside of that some absorbent cotton, and on top of it a piece of gauze or cheese cloth, and then hold in place by another collar. These strainers cost us about two-fifths of a cent each for each milking.

Mr. P. M. HARWOOD (of Barre). You will pardon me for just a word. When I buy a horse, I ask for his faults; I can find his good qualities for myself. Now, just a word as to the sanitary pail, in which I take personal interest. I have had some made, and some are out on trial, but I want to caution in the use of these pails. The pail known as the Star cooler pail is a drawn pail, — a pail without seams. It has in the top of it a shallow dish strainer, and there can be put into this the appliances which Brother Fielden has spoken about; but if the hoop is of the same depth as that dish strainer which comes with the pail, the milk may spatter out, and the milker will become disgusted. He should do what Mr. Fielden did, — have a deeper dish made. Don't think for a moment that because it is a covered pail, that will allow having the flanks of the animal covered with manure, or any let-up in the matter of cleanliness. The animal must be just as clean as possible. This special strainer is to get whatever chance dirt escapes, and also prevents floating particles of dust in the air from lodg-

ing in the milk, and that is all it is for. I felt that I ought to throw out these words of caution in the use of this pail; and I want to say, furthermore, that it appears to me there is one objection in this type of pail. The top has to be removed in order to turn the milk out, and to my mind a spout just below the upper part of the pail, with a cap on it, would be an improvement, and would avoid the slopping of milk upon the stable floor. Having experimented somewhat in this line myself, I should be very glad to communicate with farmers desirous of adopting sanitary pails. There is nothing in this, in any way or shape, for me, — no patent on it; but if I can help anybody, I shall be glad to do so.

Mr. Fielden. By putting this spout on the pail, don't you create more seams for the multiplication of bacteria?

Mr. Harwood. That is the only difficulty with it. The seams should be well soldered.

Mr. C. E. Parker (of Holden). If the lecturer will only tell us, who make milk, how we can get 40 or 45 cents a can for our milk, instead of 30, it will be worth the whole of his valuable lecture, which I acknowledge is full of fine points, well to practice; but the trouble seems to be, when you bring it home to the practical farmer, that he cannot afford to take a great deal more time to fuss with his milk, at 30 cents a can, than he is now doing.

Dr. Hills. The point the gentleman makes is one which is well taken. Unfortunately, the present circumstances and the present low price of milk are such that one cannot afford to put all these things into practice unless he takes his pay in terms of self-satisfaction.

The Chair. Will Mr. Ellis give us something towards solving the problem Mr. Parker proposed?

Mr. Geo. H. Ellis (of West Newton). One way is that of raising the price; but you can't always do that. It is a serious question, however, that is before the farmers to-day. Mr. Parker is entirely right. You can say it costs but little more to raise sanitary milk; but it does cost more, and the farmer hasn't that more. That is the simple truth.

Milk has got to bring in our markets a higher price than has been the custom. We must educate the consumers up to expect to pay that price, and that has got to be done before the farmer can do very much toward raising sanitary milk. The price must be increased, and that increase has got to go to the producer; but I don't know just how that is to be done.

Mr. Taft. Let me answer the question, — don't make it.

Mr. Ellis. They can bring milk from a distance these days, and they would do it. The contractors can get all the milk they want, and it is only a question with us of taking what they give or going without.

Dr. Hills. The contractors now control quite a number of creameries in Vermont for that very purpose. And there is another proposition. I feel fairly confident that inside of the next ten years we shall have dry milk that will be as salable as the liquid, — milk that will keep in dried form. And when that time comes, — it has already come with skim milk, and there are many bright minds working on the problem, — the competition will not be limited to comparatively a few hundred miles about Boston or New York.

Question. If a herd of grade Jerseys averaged but 110 pounds of butter, what is the trouble with the herd?

Dr. Hills. The cow census was not carried out by the Vermont station, and I personally did not see this or any of the herds. The probability is that the trouble with the herd was more with its manager than with the cows. I think if cows could vote, or could speak, they would ask very often for a new breed of dairymen.

Question. But the cost of keeping the cows is nearly as high.

Dr. Hills. Nearly as high as the average, and yet they returned, according to the creamery returns, only 110 pounds of butter. Now the chances are that, although those cows were labelled grade Jerseys, the proportion of Jersey blood in them was not large enough to hurt. The chances are, moreover, that the owner was not feeding wisely. A man well up with the times, taking that herd, would be apt to do much better with it.

QUESTION. Have you studied out the value of alfalfa over good clover-mixed hay?

Dr. HILLS. Although located in the Champlain valley, we have as yet been unable to grow alfalfa successfully, partly because of witch grass. But I expect that there is now at our local depot a ton of alfalfa meal. We shall feed this ground alfalfa hay this winter, as compared with a fairly good mixed clover hay. Next year I can tell you something as to the results.

QUESTION. You prefer trying the alfalfa meal, rather than trying the alfalfa before it is ground?

Dr. HILLS. No; I should rather try the hay, but we cannot grow it.

QUESTION. Couldn't you buy it?

Dr. HILLS. Possibly. I think next year we will try that.

QUESTION. Speaking of the growing of alfalfa, don't you think the greatest trouble with those who have tried it and made a failure is that they haven't properly prepared their soil?

Dr. HILLS. This is doubtless true. One of the reasons why the valley people are succeeding is because of the limestone character of the soil; then, too, its farmers are old sheep growers, and know how to feed pretty well; and they have to prepare their soil extra well to do anything at all with it. A thoroughly good seed bed, an alkaline soil and freedom from weeds are three of the essentials in alfalfa growing. The Champlain valley people don't need to do it, but elsewhere the use of wood ashes or of lime will sweeten the soil up so that the chances of raising alfalfa are increased. I expect to see the day when New England can grow alfalfa successfully.

Dr. HOSKINGER. It is very pleasant to speak when you speak through another person's lips, and I hope the gentleman will pardon me; but some of us who went down to Dr. Chamberlain's farm had the pleasure of seeing a large field of alfalfa which had been grown under the direction of Mr. Fielden; so, if I may be permitted, I should like to have Mr. Fielden tell those who were not there something about his methods of growing it.

Mr. Henry Fielden (of Beverly). Well, it is quite a lengthy matter, going into the growing of alfalfa; but I will say a few words. First of all I made a thorough seed bed, putting manure on it, and then I applied 30 bushels of No. 1 builder's lime, allowing it to slack on the ground; then, having it spread and thoroughly harrowed in, I harrowed that piece of ground fifteen times in order to get a seed bed. Some may think I was wasting time, but I will leave it to those people who saw the 10-acre field of alfalfa last summer. I put on 30 pounds of seed to the acre, which in the west is considered extraordinarily heavy seeding, but in the east I think you have got to, in order to get it. On the 10 acres of ground we got three crops. This year, on account of the shortage of green feed, I was compelled to feed it green to our cows, and I didn't cut off the fourth crop, due on the 18th of October. The fourth crop stood 18 inches high. I left it there for the season, which I think is a safe proceeding in this section.

Dr. Hills. How long has your field been growing?

Mr. Fielden. Two years. We have another field which grew four years. Our experience with that field was that the alfalfa lived on the parts of the field where the water would drain off naturally. In the centre of the field, where it formed somewhat of a basin and there was a chance for the water to lie and freeze, the alfalfa killed out, and for that reason I had to plow up the field this fall. In parts of the present 10-acre field that we have now there are spots where the water cannot drain off, and the crop killed off. I failed to say, also, that when I undertook to put alfalfa on that field there was more witch grass than I ever saw in my life, and I learned that I had got to get rid of that first.

Dr. Hills. When we surveyed this matter last year, I defined a permanent success with alfalfa as a field which had been in good shape for three successive years, and bade fair so to continue during the fourth year. Few permanent successes as thus defined were found in New England outside of the Champlain valley. In several sections one and two year crops were found, temporary successes, but permanent successes were rare. I hope to see Mr. Fielden's

piece in 1909, and to note whether the alfalfa or the witch grass has won out. Success with alfalfa for one year is often worth while; for two years better worth while; for three years well worth while; and if it is gone by the fourth year, one need not feel that his labor has been in vain.

Mr. Geo. H. Ellis. I regard alfalfa as highly as does any man here. I believe thoroughly in its value as a food. Experiments indicate that it is worth one-third more than clover hay. But go slow in trying it in New England. From the experiments I have made so far and those that my friends have made so far, I don't believe it pays to raise it, and it is a question of dollars and cents. I am a thorough believer in alfalfa, but I do not believe my experiments so far would warrant my spending any more time or money on it.

Dr. Hills. Our station has had Mr. Ellis's experience, and we are now going at the problem from a different direction, studying the relationship of the character and origin of the seed to success. Seed bought in the open market is apt to be that grown under irrigation in the far west, and to be ill adapted to the growth of a crop in non-irrigated northern regions. We are trying to get seed from native plants, from the volunteer plants, those which have survived for years in spots in New England, — seed which is home-grown and acclimated. If this can be done, the likelihood of success is enhanced. Mr. Ellis does well to advise farmers to go slow. Mr. Fielden was a bold man to plant at the outset so large an acreage. The generality of farmers will do better to try but a fraction of an acre, for the mental stimulus they will gain from the experiment, if nothing else. There is a fair likelihood that temporary successes may be attained; but for the present make clover your staple legume crop, and try alfalfa in but an experimental way.

Adjourned.

Afternoon Session.

The afternoon session was called to order by Secretary Ellsworth, who introduced Mr. Warren C. Jewett of Worcester as the presiding officer.

The Chair. I am always glad to preside at any agricultural meeting. I believe there is no place where I enjoy myself, a place to which I desire to go, more than an agricultural meeting. My sympathies are entirely with the farmers of Massachusetts. I am glad that so many have appreciated these meetings and what the State Board of Agriculture is trying to do for agriculture in Massachusetts. The State Board of Agriculture has always had a warm place in the hearts of the farmers of Worcester, and I believe throughout nearly the entire State.

The subject we have before us this afternoon is something which should interest, I think, every farmer here. There should be something to encourage rural progress. I have the pleasure of introducing to you President Butterfield of the Rhode Island College of Agriculture and the Mechanic Arts, who will speak on "A campaign for rural progress."

A CAMPAIGN FOR RURAL PROGRESS.

BY PRES. KENYON L. BUTTERFIELD, KINGSTON, R. I.

Ladies and gentlemen: It is with some diffidence that I attempt to discuss agricultural conditions in New England, because I have been within her borders but a few years, and I do not pretend to have made an exhaustive and minute study of the situation. But I am interested in the subject, and I suppose that my interest is enhanced by the fact, of which I am proud, that my ancestors for about two hundred years were New England farmers. I am glad to be with you to-day. I believe, moreover, that a discussion of New England agricultural conditions is worth while; that it is a subject of significance not merely to those who are immediately interested in agriculture, but to every citizen. I believe that the problem of rural progress in New England, though difficult, is capable of solution, and that it is worth solving.

We ought at the outset to face frankly the difficulties in the path. I don't mean to enumerate all the ills that New England agriculture is heir to; but since I have come to New England men have said to me, sometimes in so many words and sometimes by implication, that New England agriculture is in a bad way. Business men, living in cities, have said that not only is agriculture on a decline in New England, but that it has become relatively an unimportant industry, and that it is almost useless to attempt its regeneration. Now, whether we believe this or not, we ought not to ignore the difficulties. For instance, we can't deny the presence of these rocks; they speak for themselves. We can't deny that, in comparison with some of the great agricultural areas of the country, New England has a stub-

born, if not a depleted, soil. We know that during the past fifty or seventy-five years the New England farmer in many cases has been forced to the wall by his western competitor. I did not fully appreciate, until I came into New England, to what extent the New England farmer has had to endure a severe and constant competition from his own sons, who have gone into the rich and fertile west, there to make their fortunes on that splendid soil. It is difficult for the New England farmer to get farm labor. This crying need is prevalent all over the country, but I suppose it is peculiarly present in New England.

Moreover, the call of the city, which has been heard everywhere, and which has taken to our cities some of the strongest and best of our country-bred youth, has been unusually strong in New England. Thousands and tens of thousands of the young men and women of the farm have gone to the cities and villages. And I suppose these things have led to a condition which the presence of this audience of interested and progressive farmers before me would seem to disprove, but which I am sure does exist, because I have seen so many instances of it, — that is, the spirit of discouragement. I tell our farmers in Rhode Island that I believe that the greatest difficulty in Rhode Island agriculture is the lack of faith in agriculture on the part of the farmers themselves. There are so many who are not believers in rural progress, because they think it cannot be brought about. They are discouraged, and many times that leads to a still worse condition, — a lack of enterprise, a willingness to follow the old paths, a feeling that the young fellows out west can do this or that, or that the young men of the college can do this or that, but it is no use for the "ordinary farmer" to try. I wonder if you have any such men in Massachusetts? I fancy they are found all over New England. Now I know I am going to touch a tender spot, but we must face the further fact of the decadence and deterioration of some of the New England hill towns. I know that unwise and hasty and unfair generalizations as to the general conditions of New England agriculture have been made from superficial examinations; but I know, also, that there are altogether

too many communities in New England where the glory is departed. Not only has the industry decayed, but the whole social and moral atmosphere has deteriorated.

But I don't want to dwell any longer on this side of the picture, because my own point of view is absolutely that of optimism and of hopefulness. New England agriculture is not in such bad lines as many people would have us suppose, and I believe that the tide, however far it may have been running, has turned, and that, while we have before us a problem that is difficult, it is capable of solution; for, even if these things are true, they form an argument for a campaign for rural progress.

To my mind, the first and most important reason for hopefulness is the New England market. Nothing since I have come into New England has so impressed me as the fact of your unsurpassed markets. There is scarcely anything to equal it in the United States. You have at your doors a market made up of the very best classes of consumers, who cannot get the bulk of their supplies from a long distance at a reasonable figure. There are in New England, according to the census, three and a half millions of people living under urban conditions, — all of them practically non-producers of things that grow from the soil. They must be fed. And you have within the borders of your cities not only these large numbers, many of whom are well-to-do, with a high standard of living, but you have in all your manufacturing cities the very best class of consumers of your products, — the well-paid artisan. The market the New England farmer has at his door is, to my mind, the key to the agricultural situation and the most hopeful thing about that situation.

Then we have all over New England an increasing number of good farmers. Meeting, as I do, men from different parts of New England, and dipping into the agricultural press every little while, I keep running across instances of some man who has adapted himself to the new situation, and is making such a success financially from a small area of land as would simply startle a farmer in the middle west. A couple of years ago a gentleman took me to see a farm of 30 acres. An Iowa man wouldn't call it a farm. The man had

adapted himself to his market. He had a small greenhouse. He was doing what in Michigan we used to call "truck farming," and I was told on good authority that in the previous year he had netted $6,000 on those 30 acres. There are many instances all over New England of men who are conspicuous examples of the hopefulness and the possibilities of New England agriculture.

Another element of hope is the fact that we have men turning from the city to the country. I do not refer so much to the people from the cities who are going out to make summer homes, although that is all right in its way; but I have in my mind the rapidly increasing number of young men born and bred in cities and small towns, who have never farmed, who are tired of the city, and who are seeking to get into the country, not for purposes of recreation, but for purposes of business. Another element of hopefulness will be found in some of the statistics. I have made a comparison, based upon the last census, between the New England territory as a unit and the State of Michigan. I believe that New England ought to be regarded as a natural unit in this question of agricultural progress. The State of Michigan is an average agricultural State, ranking thirteenth in value of agricultural products. It has a little less area than New England. It has a large amount of land that has not yet been brought into cultivation. The upper peninsula has an area as large as Massachusetts and Connecticut together that has hardly been touched by the plow, and the lower peninsula contains what is left of those great forests of pine. It seems to me a comparison between New England and Michigan is fair, and I took Michigan also because I know something about it myself. Let me call your attention to the chart. I give here the round figures.

	New England.	Michigan.
Total land area, square miles, . .	62,000	57,500
Number of farms, ...	192,000	203,000
Acreage in farm, ...	20,500,000	17,500,000
Acres of improved land, . . .	8,135,000	11,800,000
Value of farms, ...	$640,000,000	$690,000,000
Value of farm products, . . .	$170,000,000	$147,000,000
Persons engaged in agriculture, .	290,000	312,000
Rural population, ...	1,500,000	1,200,000
Value of products per acre improved land.	$20	$12
Number of granges (1903), . .	1,000	550
Number of grange members, . .	100,000	40,000

You will notice that the area of improved land is considerably larger in Michigan than it is in New England. When it comes to the value of the product, however, the tables are turned. We have for New England a value of $170,000,000, and for Michigan $147,000,000. Then we have, in the case of the value of the product per acre of improved land, which represents as nearly as we can get at it from the census figures the returns to the man who is farming, in New England a value in exact figures of $20.84 per acre of improved land, while in Michigan it is only $12.42.

Is it not significant, that, while it is true that there is less land farmed in New England than in Michigan, not only is the total value of the farm product greater in New England, but the value per acre of land that is available for agriculture is vastly greater? I am quite aware that there are two factors in this comparison that qualify the conclusion. In the first place, the census figures are for one stated year, and that stated year may not be typical. We ought to have a group of years, and average the group. I am also aware that this value per acre of improved land is the gross value, and does not represent the profit to the farm; that your New England agriculture is more largely intensive than that

in Michigan, and consequently the cost per acre is greater, and it may be that the proportion of profit would be reduced. But it seems to me that, with those things considered, we still have a right to say that, when you compare New England agriculture with a fairly typical agricultural State, you not only find that New England agriculture compares favorably, but that in some respects it shows a decided preponderance over the other area. There is nothing to be ashamed of on the part of New England farmers, in spite of the fact that they tell us that New England agriculture is decadent. The trouble is, you have made a comparison between your own State, or Rhode Island, or New Hampshire, and some of those great western States. You have only to remember that your area is much smaller.

Some one may say to me, "That is all well enough, but New England agriculture is not what it once was; it may compare favorably with Michigan to-day, but it has declined." I have gone to some trouble to make a comparison between New England in 1900 and 1880. In the number of farms there was a decline in twenty years of 7 per cent. During the same twenty years there was a decline in the acreage of farms of 4.3 per cent. Still more important was the fact that in area of improved land during these twenty years there was a decline of 30½ per cent, — a most serious decline. In the case, however, of the value of the product, there was an increase in the twenty years of 64 per cent. In spite of the decline of 30½ per cent in the area of improved land, there was an increase of 64 per cent in the value of the product from the improved land; and when you reduce that to the terms showing the value of product per acre of improved land, you find in those twenty years there was a gain of 165 per cent, or nearly two and two-thirds times. If those figures have any significance at all, they indicate that during the past twenty years not only has New England agriculture not been declining, but it has been making a most marvellous and rapid progress.

Just one word more about this matter of comparisons. Taking the State of Massachusetts alone, we find that it is among the first of the New England States for value of

product per acre of improved land, and the gain has been great during these twenty years. For instance, in 1880 the value of the product per acre of improved land in Massachusetts was $11.35; in 1890, $17; in 1900, $32.73, which you see is much above the average for New England, — $20.84.

If there are any in this audience who are residents of the city, business men, I want just a word with you. It seems to me that from the standpoint of a citizen of New England, irrespective of your occupation, it ought to appeal to you that New England agriculture is worth saving. In the first place, because it is of advantage to you, immediately, personally. It is of advantage to you to have New England farm products. You can never get the same products from a distance that will compete on your table with the products grown within a reasonable distance. It is for the interests of your artisans that they shall be able to maintain a fair standard of living. It means considerable to your manufacturing industries that that should be true.

But from a broader standpoint, New England agriculture is worth saving because of its importance as an industry. I want to bring in a few more figures. As I understand it, the greatest group of manufacturing industries in New England is the textile group, — the manufacture of textiles. I understand that New England leads the country in this respect. Now, according to the census of 1900 the capital invested in the textile industries of New England was somewhat above $525,000,000. In the same year the value of the farms of New England was $640,000,000. In the State of Massachusetts, according to the census, the largest single industry is that of cotton goods manufacturing. There was invested in the cotton goods manufacture in Massachusetts a capital of $156,000,000. The same census of 1900 gave as the value of the farms, including buildings, live stock, etc., in Massachusetts, $183,000,000. The city of Boston is one of the seven or eight largest manufacturing cities in the United States, and the largest manufacturing city in your great manufacturing area of New England. According to the census of 1900 there were over 7,000 manufacturing establishments in that city, and they had a capital invested

of $144,000,000, which, however, comes nearly $40,000,000 short of being the value of the farms in Massachusetts in the same year.

Now, these figures also may be subject to qualification, of course. You have on the farms the value of the homes, and you have perhaps an exaggerated value of some farms nearer the suburban towns and large cities; but, taking these things out, you still have a comparison right in the heart of your manufacturing district, with your choicest manufacturing enterprises, that is not discreditable to agriculture.

And then there is the social significance. A million people are still living on farms in New England; and I submit that any question that concerns a million of your people, — I don't care how many millions you have in your cities and villages, — any question, industrial, social, educational, religious, that concerns a million of your people, is a significant question for you as citizens of the Commonwealth or of New England.

Then, in spite of the fact that the rural population of New England is not the major part of its population, there is still coming from New England farms a great stream of young men and women to your cities. Now, you who live in cities take great pains that your water supply shall be pure from its sources, and you have reservoirs built up on the hills, where the water shall come from springs of living water, and you make sure that that supply shall not be contaminated on the way from the reservoir to your house. Is it any less important to you in the cities that you shall maintain up among the hills of New England reservoirs of human character that shall send down their streams to you uncontaminated and pure?

But I like to think of the country as something more than a breeding ground of thorough-bred stock for the city. I like to think of the country, no matter what proportion of the population the country people may be, as contributing to our American civilization. It is well enough that we shall have an open avenue from the country to the city, — God forbid that it should ever be closed! But we want to maintain upon our farms a class of people that represent the

very flower of our American citizenship. And it is just as significant to you who live in the cities that that shall be done, as it is to the people who live in the country.

Now, my subject is, "A campaign for rural progress." What do we mean by this campaign for rural progress? If we are going to have such a campaign, we must have something definite as a goal. We must first of all seek to secure such conditions, of such a character, that a young man can hope to find a fairly satisfactory business career upon the farm; that is fundamental. But we want also a prosperous industry as a whole. The two things may not go together. It may be perfectly possible that agriculture shall offer a splendid opportunity for a few individuals, and still the industry as a whole lag. We must bring about, if we can, such conditions that the mass of people who are tilling the soil shall be fairly prosperous. But we must have also a more satisfactory rural community, socially, educationally, religiously,—a community that is a good place to settle in, not merely a good place to be born in and to get away from. And we must not forget, in all our discussions about dairying and fertilizers and about the business aspect of agriculture, that on these as a foundation we must build up better rural communities. In other words, we want to try to maintain upon our farms, if it is possible to do so, a class of typical American farmers, who are neither large landlords with a host of attendants, nor a mass of ill-educated, ill-fed peasantry. If we could have our way, I think you will agree with me that we would like to have on all our New England farms just the same type of man,— who has adapted himself, of course, to modern conditions,— but essentially the same type of man as built up these Massachusetts farms years ago; the same type of man who went out from New England and has made the great middle west what it is to-day; the typical rural citizen, land-owning, living on a farm of moderate size, making enough from it to give his family a fair education; a man intelligent, broad-minded, patriotic. It seems to me that is the goal, after all,— that this sums up better than anything else the end and aim of all our efforts for rural improvement.

If we are to have a campaign for rural progress, what is our ammunition, what are our weapons? Of course the thing we must do, above all things, is to reach the individual farmer. He is the key to the situation. But I believe, under modern conditions, that which is to turn the key is some form of social institution. I think that in the use of these social institutions or agencies there are three general principles: the first one is science, research, finding out the truth; the second is education, which is disseminating the truth; and the third is co-operation, which means working together. I believe all these three principles must govern in any attempt at rural improvement.

Now, what are the agencies which are to work out these principles? I believe we have at hand already the chief agencies of rural progress, and I would name four general classes: first, the State; second, the schools; third, the voluntary organizations; and fourth, the church.

I speak of the State as having a special function, which might perhaps be expressed by the word "control." For instance, the State takes charge of the question of commercial fertilizers, to be sure they are of standard grade. I suppose that in New England the State would act through its Board of Agriculture; and I am not here to say what the Board of Agriculture of Massachusetts, or any other State, shall attempt to do. The history of the boards of agriculture in New England is a history of splendid achievement. But by way of illustration I want to suggest some things which it seems to me the State boards of agriculture may do, that will make for rural progress. I believe in New England one of the great difficulties has been that the farmer has not adapted his farm to its best possible use. There has recently been made by the United States government a soil survey of the entire State of Rhode Island; and if you take the map of Rhode Island made by that soil survey, you will discover the greatest divergence of soil between communities that are very close together. And I suppose, generally speaking, the same condition prevails all over New England. In Rhode Island, at least, except near the cities and in a few special cases, there has been no general attempt to adapt

each particular farm or each particular area to its best use. There are thousands of acres that ought to be in forest. There are other thousands growing up to brush that ought to be in orchards and poultry farms to-day, and would be, if the farmers would adapt their soil conditions to the general market conditions. To my mind, one of the fundamental things in rural progress is to know the facts; and therefore I would like to see every State work out a sensible, practical, thorough agricultural survey of all its territory. Let the State authorize its Board of Agriculture, with the assistance of the college and station people and practical experts, to make actual and careful surveys of the State, and make maps that could be used by the practical farmer.

Moreover, I see no reason why, when this is done, the State, through its Board of Agriculture, or otherwise, may not try to induce people to settle on those lands. This may seem a queer proposition to the people of Massachusetts. You will say at once that it savors of the western "boom" methods. Well, perhaps it does. But let me tell you an incident. A gentleman who is known all over this country for his scientific work, and who has resided in the middle west a good many years, has a boy who wants to follow horticulture. The father wanted to buy the boy a farm. He travelled all over the country, and saw the land in many of the States in the south and middle west and the west. He spent several weeks trying to find a fruit farm adapted in the best possible way to his boy's work. He went to Florida, California, Minnesota, — he investigated the whole country; and he finally bought a fruit farm at a moderate price in the lower Connecticut valley, not very far from here. The choice of the whole country before him, — he came back to New England.

Now, it may sound strange in your ears, but I believe firmly that there are thousands of men in the middle west who want to follow special lines of farming, such as New England is adapted to, who have no capital, who haven't money to buy some of the high-priced farms in the middle west, who could be induced to buy many of your cheaper

New England lands, which would be adapted to their special purposes, if they only knew about it. I have faith in such a plan, but it must be based on a thorough understanding of the conditions of the soil, the market, and all that.

And there is the question of farm labor. What objection is there to having the State, under some auspices, act as a sort of clearing-house to help furnish farm laborers to the people of the country? I see no reason why it cannot be worked out, if carefully managed.

In the second place come the schools. I will spend but a moment on the schools, because I suppose President Stone treated of that subject very fully last evening; but I want to call your attention to the fact that you must deal with this question of education in a very large way. We have done something in the matter of agricultural education, but we have made just a beginning; and the New England States must be much more liberal in their appropriations, much more enthusiastic in their support of educational institutions that have to do with rural people, than I think they have been, if they are to have rapid rural progress. Take, for instance, the rural schools. I know nothing in detail about the rural schools in Massachusetts, but I believe there are two things that may be said about them anywhere. One of them is, that the country school should be as good as any other school. I understand in Massachusetts you try to make it so by large contributions from the State. The country school must be loyal to agriculture. In my opinion, it hasn't been, — perhaps not because it meant to be disloyal, but the teachers and the text-books have so often, consciously or unconsciously, led the mind of the boy and girl away from the farm toward the city.

I have no fault to find with the country teachers. Thousands of them have done splendid work, and are doing it to-day; but the teacher has not been able to make the boy see that there is a chance in agriculture. The country boy has not been taught in schools to understand that right around him is the source of the richest kind of life, is a means of growth and development and genuine pleasure as well as a means of livelihood. And the rural schools, if they are to do their work, must seriously and thoroughly take up the

question of creating in the minds of pupils this sentiment for agriculture. Not that they will try to keep them all on the farm, but that they will teach the child the riches of country life. In other words, you must introduce into our common schools nature study of a sort which will eventually lead to the study of agriculture.

Then we must have — what we don't have to-day — a complete system of agricultural schools, which will take the boy (and the girl too, for that matter) from these common country schools and give him a school training *in* agriculture and *for* agriculture.

Now, just a few words about the agricultural college. The agricultural college, to my mind, must do three distinct things. They are equally important, and not one must be neglected.

First, it must experiment. It is doing that through the experiment stations, but it is only making a beginning. The experiment stations in our country need more money and more men. They are just beginning to find out what their work is.

In the second place, the colleges must teach students who are going to farm. There used to be an idea among agricultural people that the college was to train men for experiment stations or professorships, and now and then a manager of a great estate where they pay great wages ; and that it was not expected to train farmers, because a boy who wants to farm cannot afford to go to college four years and then go back to the farm. If that were true, then my hopes for agriculture in this country would be very gloomy indeed. We must have conditions such that a man of average ability, even if he doesn't have a large amount of capital, but if he does go through college, shall be able to find a satisfactory career upon the farm. One of the functions of every agricultural college in New England is to educate a vastly larger number of young men for agriculture than they are educating to-day. The tide has turned in the middle west; the agricultural colleges are growing. I believe the tide is turning in New England, and that in the next few years we shall witness a wonderful development along this line.

What we most need in New England is not so much a

larger number of men working in experimentation and teaching as professors of agriculture, although those things are vastly important; but we need a group of college-trained, bright-minded, well-equipped young men, right on our farms, who are taking the leadership not only in showing that farming will pay, but are taking the leadership in all this work of rural progress, the improvement of the rural community. If you could put every year such a man as I have described into each one of your Massachusetts towns, the rural problem would be solved.

But there is a third thing which the agricultural college must do. It must get into close, intimate, personal touch with every man that tills the soil. Now, I like to call this "extension work."

The college will miss one of its most important functions, it will be shorn of a large share of its possible power, if by some means it does not reach out a helping hand directly and immediately to the practical farmer. Personally, I believe that every agricultural college in the United States ought to have in connection with it a thoroughly equipped extension department, manned by the best men available, men who know how to reach the farmers, although they are also well trained scientifically and possibly know the business practically, — a faculty of men whose business it is to go out and by word of mouth or by printed page give information and inspiration to every farmer within the borders of the Commonwealth.

I named the voluntary organizations as a third agency. The village improvement society, the farmers' club, the various organizations of farmers, — these things are vital factors in rural progress. The grange is perhaps the best example of all. The work of the grange, it seems to me, is not appreciated by many people who do not belong to it, and do not know its purpose and the kind of work it is doing. You can't have a well-rounded development of your agricultural community, speaking now in a large way, unless you have well-developed farmers' organizations. You need them to express the class power. You need them to get the farmers to work together for common interests.

You need them as spokesmen of the farmers' wishes, and in order that they may bring the class influence and class intelligence to bear upon the general question of citizenship and development of our American civilization.

Finally, the church. The country church offers a hard problem. Most of the country churches are small, and must have very small financial resources. Many of the country parishes are regarded as undesirable. Sectarianism is one of the worst foes of the country church. There are too many churches. I wish we could have in every community one strong, united church. I regard the question of the rural church as equally vital with any of these others I have mentioned, and I believe, for one, that there lies before the church in our rural districts one of the most splendid opportunities that the church has anywhere. And the time has come when the church as a whole ought to take hold of this question of the country church; ought to realize that the country church has a function not only in trying to save individual souls, but it has a function also in trying to bring about better conditions generally in the farming communities. The country church is intimately related to all the other elements of rural prosperity. I don't believe the church anywhere is so closely related to the industrial development of the country as it is in the rural districts. You can't maintain a good church, if you have a decadent agriculture; and if you have a prosperous agriculture, it doesn't follow that you will have a good church. The rural parish offers a field of service scarcely equalled. The pastor who will train himself for the country parish, who will seek to know something about the problems of the farm, in addition to all his theological training, has a rare opportunity.

In what does the campaign for rural progress consist? In the first place, we must understand what we are "driving at." All of us, whether we are in the church, the grange, the board of agriculture, the college, or are "just farmers," must understand that the goal of rural progress is not merely business success to the individual farmer, not merely the industrial prosperity of the business, not merely a better rural

community, but it is also the development of all these in a great harmonious whole.

And, secondly, the campaign will consist of utilizing all of the means at our disposal. I have heard enthusiastic grangers — and I am a good granger myself — talk as if the grange were chiefly responsible for rural progress. It is true, if you were to take out the work of the grange from any community where it has successfully existed for some time, you would change the history of the community. But the grange can't do everything.

I have heard some country pastors say, "You must make the church the social centre; it must be the nucleus around which must be gathered all social things." I like to hear them talk like that. But there are other means, and we can use them all. No matter what our prejudices are, if we are to have a genuine campaign for rural progress, we must use all these means, and use them to their full. Let the grange go on, let the country church enlarge, let our boards of agriculture do still more work, let our colleges increase their work, enlarge the functions of our schools.

But if we are to have a genuine campaign for genuine rural progress, we must have co-operation among all these means; because no one agency is enough, because they have common work, and they ought to see the common problem, and they ought to see their relation to that common problem. Then, when they see the common problem and see their relation to it, let them work together.

My recipe for this idea of co-operation is a "conference on rural progress." We have tried this in Rhode Island. We got together the granges, the State federation of churches, the superintendents of schools and anybody else that was interested, — just brought them together in a common meeting place, on a common platform, and talked over all these different phases of rural development. The trouble is, the farmers, the dairymen, the board of agriculture, the granges, hold their separate meetings, and they look at their little corner of the problem. Now, we have tried to bring together all these different agencies, to look at all the phases of the rural problem, and have tried to get a view point

which took in the whole situation. I wish they might have in every State in the Union a conference every year, which would discuss this rural question from the wider view point.

And this leads me to express what shall be my closing thought. I wish that I might impress upon you the idea of making New England a unit for rural progress. We who were born out in the west think of New England as a place, — we don't think of it as six States; and yet I find your State lines are high walls. But it seems to me if we could impress upon the people of New England that it is a natural unit, something could be gained. You have in all your States a great similarity of conditions of soil and climate. Your markets are the same, you have the same history, much the same traditions, about the same difficulties, about the same means of solution. Why should not New England be a natural unit? Why should not New England States and people work together for this purpose of developing rural life within her borders? You have the equipment for the campaign. In Iowa or Michigan they have one agricultural college or experiment station. Here you have six colleges, six experiment stations; you have several boards of agriculture; you have a thousand granges; you have the largest grange membership and the largest number of granges in a similar area of any portion of the country. You have men of wisdom and wealth and leisure, who would be glad to help; and I think myself there is no reason why the farmer should not accept the genuine interest and aid of the people of the city in solving this problem. You have all this equipment; there is nothing to compare with it anywhere in the United States. Why should you not make use of this equipment, not in little, separate doses, but in one great campaign? Why should not the agricultural colleges co-operate? Why don't the granges understand each other better? What is there to hinder this unity of interest all over New England? And there is the idea of sentiment, — and I speak as a great-grandson of New England. It seems to me, if there were undertaken a campaign for rural progress, it ought to and would arouse the

enthusiasm of every son and daughter of New England, whether living within her borders or under other skies. Is it impracticable to think that in the near future there shall be undertaken a New England campaign for rural progress?

During the English mutiny of about fifty years ago the city of Lucknow was besieged. General Havelock managed to get word to the garrison that if they would hold out for fifteen days he would come to the relief of the city. Although sorely besieged, they held out the fifteen days, but no relief came. They held out twenty-five days, and no relief came. There were women and children there, and there were suffering and torment, and disease and death. The weary days wore on, but the garrison would not give up, although the case seemed hopeless. "And ever aloft on the palace roof the old banner of England blew."

Finally, one morning, after weeks and months of suffering, and cholera, and scurvy, and starvation, and death, ears that were strained to catch every note of hope heard over the distant hills something very like the sound of the pibroch. Finally they made sure that they caught the strains of the old Highland war song, "The Campbells are coming."

All on a sudden the garrison utter a jubilant shout,
  Havelock's glorious Highlanders answer with conquering cheers;
Forth from their holes and their hidings our women and children come out,
  Blessing the wholesome white faces of Havelock's good fusileers,
Kissing the war-harden'd hand of the Highlander, wet with their tears.
  Dance to the pibroch! Saved! We are saved! — Is it you? Is it you?
Saved by the valor of Havelock, saved by the blessing of Heaven!
  "Hold it for fifteen days!" We have held it for eighty-seven!
And ever aloft on the palace roof the old banner of England blew.

It may be that New England agriculture has been besieged; that the New England farmer has had to contend with a rocky and even a depleted soil; that he has had to face the competition of the rich prairies of the west; that he has found it difficult to secure an adequate labor supply; that the call of the city has robbed him of the strong right arm and the stout heart of his son and his daughter; that he has become discouraged, and has lost faith in his occupation and in himself, — in some cases has become unenterprising;

that there are some hill towns of New England, once its glory and pride, that have fallen to decay. But I believe, if New England agriculture has been besieged, help is coming. I think I catch the note of the pibroch. I think I see coming over the New England hills the army of relief. Over on the left wing there are banners, and on these banners is inscribed the word "Science." And I see men there with the microscope and the chemical test tube, trying to bring to light the hidden secrets of nature, and to lay those secrets at the feet of the farmers of New England. Over on the right wing I see a banner, and on it is written, "Education." And I see an army of men and women bringing to bear upon all the problems of agriculture the great force of intellectual training in the common schools, in agricultural high schools, in agricultural colleges. And in the centre of that army I think I see the advancing forces of "Co-operation," which are bringing together, shoulder to shoulder, the masses of farmers, thus educating them, training them, developing them. I think I see that entire army, wings and centre, marching to the relief of New England agriculture. I think I see the banner of rural progress once more flying aloft, and I think I am witness of the dawn of the golden age of New England agriculture.

The Chair. Any one who had watched your faces as I have would feel safe in saying that you have enjoyed every word of the lecture. Perhaps it is well to be proud that we have made some advance, but still we ought to remember that we haven't made the advance we should. The great possibilities of agriculture as set forth by the lecturer ought to do every one of us good.

Mr. Wm. H. Bowker (of Boston). It is good to hear from this man from the west, and his hopeful views touching New England agriculture. Perhaps he is one of the many agents which the west is to return to us, to help us to solve these problems. I am not on my feet, however, to speak particularly of the problems that have been discussed here, but more particularly to ask the lecturer to describe somewhat more in detail his method of what he calls extension

work, — the reaching out of the hand, the glad hand and the helpful hand, to the practical farmer here in Massachusetts and in New England. He comes from a country where they do great work, and he has helped to do some of it, and I would like to know some of the details of that work. In the west and I think in Rhode Island they send men from house to house in the rural districts. I wish he would tell us some of the experiences of these men, some of the hopeful things as well as some of the discouraging things which they are running up against.

President BUTTERFIELD. To show the scope of extension work, I may say that Cornell University has spent $50,000 a year on extension work, in addition to $20,000 spent by the Commissioner of Agriculture for farmers' institutes. Other institutions are also doing it, as you probably know, — some in one way and some in another. Down in Rhode Island we have organized an extension department because we want to have it known that extension work is a legitimate function of the college work, and we have a superintendent of college extension. He gives demonstrations in spraying and that sort of thing. Then he tries to get in touch with the granges and other organizations by giving lectures himself, and also by arranging for lectures by the faculty. We find that this work is developing quite rapidly, and they are calling for our men more than they used to. Then the superintendent tries to get into touch with the country schools, and is visiting those schools, getting acquainted with the teachers, with the superintendents; and is organizing what he calls "nature guards," — little bands of pupils who are doing nature work, or making school gardens in the country and city schools. Then we have carried on what we call "a carpet-bag campaign." We were much pleased with it. We had a man from Michigan for a month, a practical farmer, thoroughly up to date, and we "turned him loose" in northwestern Rhode Island. He went around from farm to farm, simply doing missionary work, trying to find out all he could about conditions, and lending such aid as he could to inquiring farmers.

At Cornell they not only make agricultural surveys, get

in touch with the schools and bring teachers to the university for summer school work in agriculture and nature study, but they send out a constant procession of leaflets on nature study; they organize nature clubs with thousands of members all over the State, and send literature to them and keep corresponding with them. They have also developed a system of reading leaflets for farmers and farmers' wives, and aim to reach farmers and farmers' wives who do not attend farmers' institutes, who do not take the best agricultural papers, who do not read the bulletins from the experiment station. The better class of farmers is pretty well served to-day; they have the farmers' institutes and station bulletins and agricultural boards, and perhaps do not need this sort of thing. But nine out of ten farmers do not go to farmers' institutes; I do not know how many out of ten, but more than you imagine, perhaps, do not take farm papers; and a large majority do not belong to the grange or any other similar organization. I believe it is the mission of the college to do what it can, together with these other agencies, to reach every last man that tills the soil in every State in this Union.

QUESTION. What effect upon rural progress would the closing up of the rural schools have?

President BUTTERFIELD. I suppose you mean centralization. I have no data from which to speak on that subject. It seems to me that the theory of centralization is a good one, providing the matter of transportation can be solved practically. I think centralization depends for its success quite largely upon the success with which you can transport. As far as the centralized school is concerned, it *ought* to secure better teachers and give a better chance for nature study and agriculture in the upper grades; but whether it really is a good thing or not, under existing conditions, I do not know.

Mr. BOWKER. Would you introduce these nature studies into city schools?

President BUTTERFIELD. Certainly; I think there is a pedagogical reason for nature study as a part of the curriculum of every modern school. I do not know as I would

introduce agriculture in the city schools; that depends on the conditions. In New York there is a feeling that the ordinary village high schools should have an agricultural course.

Mr. BOWKER. You know in Massachusetts there was appointed last year by Governor Douglas a Commission on Technical and Industrial Education, of which the Hon. Carroll D. Wright is chairman. Some of us appeared before that commission the other day, and the question was put by Mr. Bowditch of this Board and a member of that commission, if we would have these nature studies introduced into all the schools, country and city, — for, being State work, it concerned all the schools; and whether we would make them compulsory studies in certain grades, or in all the schools. For my part, I was not prepared to answer the question. Perhaps you are.

President BUTTERFIELD. Of course I can't speak with any knowledge of the conditions here, and so much depends on the conditions. A number of southern and western States have made compulsory the study of what you call agriculture in the primary schools, and they claim it is working well. I have my doubts about the wisdom of making a State law requiring the teachers to prepare themselves to teach agriculture in the common schools. Very properly the nature study introduced into country schools may differ from that of the city schools.

Mr. BOWKER. Although it is time to adjourn, I want to add a word more touching the matter under discussion. We have much missionary work to do in this State, and first among the teachers in our public schools. This is where we must begin, for I am afraid that the teachers, both in the country and city schools, are still in favor of what is termed the old school or classical education. They are not yet alive, it seems to me, to the new educational movement, the new idea, — namely, that many of our studies, particularly the natural sciences, can be made cultural as well as vocational in their application; that these studies can be taught in such a way as to broaden a man and make a better citizen of him, — a man who can stand up and fight for a

cause, — as well as to prepare him to follow some vocation. There are teachers in this State — I know of one in particular, in one of our rural towns, who, when a bright boy went to him to consult him about going to the Agricultural College at Amherst, said, "Do you want to be a farmer?" The boy did not know. "Well," said the teacher, "if you do, why, then, go up to Amherst; but if you are not sure, I would advise you to go somewhere else," naming two or three old-line colleges. It is my feeling that the majority of the teachers in the State would have given the same advice. Now, the teachers may not be altogether to blame, for they may be uninformed as to what we are doing at Amherst, and therefore one of our first duties must be to set them right, — to enlighten them; and in this work we must enlist not only the aid of this Board, but particularly of the Board of Education. We aim to teach the boys who go to Amherst, first, to be good and useful citizens, to do their part in society; then we train them along vocational lines. As a result of this training, more than half of our graduates are now engaged in agriculture or allied pursuits. So practical and useful has been the training at Amherst, that the graduates are soon settled in some pursuit, nearly every man in the last graduating class being placed before he graduated.

I want to say, further, that we are drawing the larger part of our students from the city and the town, and not from the farm; and I, for one, do not object to it, — I think it is a good sign. We must remember that the college was established for the whole people, and not for any particular class; and I like to see boys come from Brockton, Natick, Worcester and Boston. For generations we have sent our boys from the farm to Boston and Worcester, and now I like to see Boston and Worcester and other cities reciprocate by sending their boys to Amherst to be educated at our Agricultural College; and when we get them there, we turn many of them to country pursuits and country life. It is a kind of reciprocity which I believe in encouraging, and which the college is helping along. This Board and the Board of Education, and particularly the public school

teachers, if they will, can also help it along; and it will be a good thing from every standpoint.

Mr. Geo. M. Whitaker (of Winthrop). I attended a conference of teachers in nature study not long ago, and it was actually surprising to note the advance that is being made. Our city schools in Massachusetts are already doing a great deal of very advanced work in nature study.

Mr. James Draper (of Worcester). I think we sent twelve or fifteen boys from Worcester to the Agricultural College last year, and that speaks well for the city.

Adjourned at 4 P.M.

Evening Session.

The evening session was called to order at 8 o'clock by Secretary Ellsworth, who said: Ladies and gentlemen, this evening was set apart for the citizens of Worcester to extend to the Board and its speakers and invited guests a sort of reception. It was expected that our Governor-elect would grace the occasion with his presence, but he has informed me that on account of illness he will be unable to be with us. I know you will all unite with me in wishing Governor-elect Guild a quick return to health. We have with us, however, several gentlemen who have kindly consented to make brief remarks.

It is my pleasure to introduce to you Hon. Ledyard Bill, president of the Worcester Agricultural Society, who will be the first speaker of the evening, and who will preside.

REMARKS OF HON. LEDYARD BILL.

Mr. Secretary, gentlemen, and shall I say fellow farmers? The Worcester Agricultural Society has the largest membership of any similar society within the borders of the State. We have on our rolls nearly two thousand members in Worcester and vicinity, in central Massachusetts. It is also one of the oldest agricultural societies in the Commonwealth, formed, as I learn, in the year 1818, and is one of the most active societies in the State to-day. It is also, I suppose, the wealthiest agricultural society. We are located in one of the wealthiest farming districts not only in this State but

in the country. As the mayor said yesterday morning, in his words of welcome, Worcester has two sides, — one the industrial, excelling in many respects any city of equal size in the United States, while on the other hand its agricultural work is distinguished. Our society has given to the people of Worcester and central Massachusetts some of the best exhibits within the borders of the State, and I say this advisedly, as I have visited about all the notable fairs within her borders.

But we have heard yesterday and to-day of the importance of scientific matters; that a great change has come upon the business of agriculture within a period of ten to twenty years, by reason of the valuable influence of our colleges and scientific investigations; and undoubtedly this is true, that they have advanced agriculture, have raised the business to a dignified position. Many thanks to these investigators and colleges, and I may also say to the State Board of Agriculture, for its members have done much towards promoting the hopes and higher interests of the farmers of the State.

There has been a great advancement in the value of lands in our country within the last twelve months and within the last decade. The lands of the west, which have been so open and so free to settlers and to anybody who would go and build a home by invitation of the government, are about all absorbed, about all taken. The free acreage is gone, and now the tide begins to set back to the older portion of the country; and the abandoned farm question is solved and the price of lands increased. The time will be within the memory of those here now when there will be a wider-felt immigration from the west into New England, where the loveliest land, I may say, on the face of the earth, exists, — loveliest in its hills, beautiful in its valleys, health-giving in its streams and springs, and with all the luxuries that come with civilization. Massachusetts, though it has a somewhat sterile soil, yielding but little without severe labor unless you use skill and judgment and scientific information, is sure in its agricultural conditions to be vastly improved in the near future. It excels already in many things that go to make a home desirous. We have more colleges

and other educational institutions in Massachusetts than exist, of like character and rank, in the entire west. We have greater conveniences for travel and transportation. We have steam roads and electric roads spreading out like a spider's web all over the land, and finally the despised auto has come, and come probably to stay; and it won't be many moons, as the phrase is, before the farmers will have them ready at their doors to take care of their market-garden and other crops, thus saving in the cost of transportation of their products to the nearest market. This is sure to come.

We may all feel pleased and proud that we not only live in a country of liberty and good government, but also that we live in Massachusetts, the greatest State in the world.

I now have the pleasure, my friends, — a great pleasure, — of introducing one of the oldest, one of the most successful and one of the best citizens of Massachusetts, Hon. O. B. Hadwen.

REMARKS OF HON. O. B. HADWEN.

Mr. Chairman, ladies and gentlemen: I am unexpectedly called upon, and have nothing prepared, and consequently I must speak of the Horticultural Society, with which I have been familiar since its very organization and incorporation. The society was organized in the autumn of 1840, and held its first exhibition in October of that year. I was a lad of some sixteen years of age, and recollect perfectly well the exhibition which took place at that time. It was held in the town hall, a building which stood opposite this building, upon the common. It was a new thing, worked up by some distinguished citizens who had a natural fondness for horticulture: in fact, their residences were rural, had lands attached, and they wanted to stimulate the interest with which they were so well connected. The exhibition itself being the first and the contributors comparatively inexperienced, it was rather a meagre affair. There were long lines of apples, but few of them correctly designated by name. They also were favored with some large exhibits in the vicinity of Boston and the Massachusetts Horticultural So-

ciety, which helped out the exhibition to a considerable extent, giving our people something new in relation to apples and pears. They also put in a collection of pictures, which added to the attraction; and, finally, every one seemed to be quite satisfied in those days with the exhibitions as they witnessed them.

We have had many distinguished men who have been members of this society. We have had in our membership four Governors of the State. Upon my right, the central picture is that of Governor Lincoln, the Governor of the State nine consecutive years, — something that has never taken place either before or since. He was one of the most courtly men that I have ever seen. He was very fond of agriculture and of horticulture, and accomplished a work in Worcester at that time that no other person ever accomplished. In fact, his place has never been filled, and I am afraid it never will be.

The next benefactor of this society is Mr. Daniel Waldo, whose picture is at the head on my left. He made a bequest of $3,000 at his death. That proved the nucleus which purchased this spot of land. Some few years after his decease a meeting was held by the society and trustees in regard to purchasing a piece of land for a building, and I believe I am the only person living who attended that meeting. The others were advanced in life when I was quite young. But this piece of land was purchased. In 1852 this building was erected, and has been in the possession of the society ever since.

This past year we have had twenty-five exhibitions, covering everything in fruits and flowers and vegetables in their respective seasons; in fact, we have everything in its prime. Our exhibitors being called upon so often, and having such training, which no fair exhibitors can have, become experts. Their selection of fruits and flowers and vegetables is unequalled by the training received from weekly exhibitions. A yearly exhibition cannot begin to do the work. Then, during the winter, we have ten meetings for discussions and papers upon horticultural subjects. In March we have our annual banquet, which draws together the whole society in

a social way, and our rooms are filled, and everybody has a good time.

On these walls are pictures of many distinguished persons. One man in the rear is a man by the name of Paine. The Paines were one of the older families of the town. The grandfather of this Paine, who was our treasurer for many years and as long as he lived, had a mansion on Lincoln Street.

The Chair. I have the pleasure of introducing Burton W. Potter, the retiring president of the Worcester Agricultural Society.

REMARKS OF BURTON W. POTTER, Esq.

Mr. Chairman, ladies and gentlemen: We heard this afternoon a lecture on a campaign for rural progress, and I was very much interested in the subject, and what little I have to say I desire to say in reference to that. When we talk about rural improvements, almost every one thinks it is an academic or scientific question, and not a practical one; but it seems to me the relation of civic with rural life is a very big subject, and this question of institutional against natural life is also a big subject; and when we solve those questions, we settle a good many of the unsolved problems of society.

I attended a meeting the other night, where the statement was made that 39 per cent of the taxation of Worcester County was paid for the support of criminals and the courts in handling them, and that the chief source of this expenditure was in the streets, the crowded streets, of our cities; that that was where the juvenile offenders come from, where the drunkards come from, where the depraved come from in all other departments of society. Now, if you could abolish the slums, and arrange things in some way so as to get rid of these crowded tenement settlements and bring people out into the suburbs of the city or into the country, you would eliminate the criminals, or a large number of them, from society, and the community would not be called upon to pay such a large expenditure for their support.

A prosperous agricultural people are essential for the

success and permanent prosperity of the country. It has always been so, and always will be so, and we have a good example of that in the present day in Japan. Japan is only about as large as New England, yet their agricultural operations are so intensive that they support a population of 40,000,000 people, and they export more agricultural products than they import. It is that influence in that country which has enabled them to fight with the great Russian power and to come off victorious.

I fail to see how the cities can take care of themselves. In ancient Rome, when the social and political corruption was at its height, when everything there was rotten to the core, and society was ripe for destruction, it was the rural people in Italy, the provinces, that maintained the empire in its possession and power for hundreds of years. And the same thing is true of France. Take Paris to-day. If it were shut out from the rest of the agricultural provinces of France, it would go to ruin in no time, and I think the same thing might as well be said of New York. It is nothing but the pure blood that comes in from the country to the cities that enables those cities to maintain themselves at all.

The speaker this afternoon also said something that I wish to call attention to. He was glad, he said, that the rich people in the cities were going to the country to establish homes. Now, I wish to say just a word in regard to that. I think that that is a good thing, and I hope that many more people in the city, who can afford it, will go into the country; but I think that this should be said, — that when these people go from the cities into the country they should not try to build a Biltmore or some palace, and spend hundreds of thousands of dollars for establishing some city home in the country. If they would go into the country and establish nice rural homes with ordinary buildings, without such a lavish expenditure of money, it would be very much better, and these establishments that they build could then be used by somebody else besides millionaires. How often we see somebody go into the country and build some such establishment as that, spending hundreds of thousands of dollars in fixing it up like a palace; and when the pro-

prietor dies there is nobody that is able to carry it on or buy it, and it stands vacant and unoccupied, without being any particular good to the community in which it is placed.

I also wish to say one thing more, and that is, in regard to the people in the country themselves; they should make it a point to improve their old homesteads, and make them as beautiful and attractive as possible. The great fault of the country people is that a great many of them think, when they undertake to make any improvement, that they must citify their rural home. They have seen granolithic and asphalt sidewalks in the city; therefore they must have granolithic and asphalt sidewalks. They have seen cast-iron doors or lamps or some other such thing in some city place; therefore they think they must have that thing there; and they must have an iron kettle with some plants in it, and all sorts of things of that kind, to try and make their country home look like a city home. That isn't what you want; you want to make your country home look rural; make it plain, make it simple, and then you have something attractive. When we are riding through the country and reach a home that shows good taste, shows improvement, you at once say, "They must be very intelligent and nice people that live here," and you would like to become acquainted with them. And I say that this can be done without any great expenditure of money. All that they need to do is to have green grass and trees, and they are cheap. You don't want an Italian garden in your front lawn. You simply want to bring the glories of the field and of the woods around your doors, and then you have a rural estate, in which you can live in enjoyment, and which is attractive to every eye of good taste.

The CHAIR. I have the pleasure, ladies and gentlemen, of introducing Pres. Harry W. Goddard of the Board of Trade of this city.

REMARKS OF MR. HARRY W. GODDARD.

Mr. Chairman, ladies and gentlemen: The Board of Trade of the city is composed of farmers, mechanics, merchants and manufacturers, and any one else in the city who believes in the upbuilding and the progress of Worcester. We are sometimes asked what good the Board of Trade does, and it is rather a hard question to answer. We have no exhibitions such as President Hadwen described, or such as the Agricultural Society have had, — although some one once said, jokingly, "I think we exhibit ourselves at our banquet." The farmers of the Board of Trade are entitled to just as much consideration at the hands of the Board as any member. In their way they are of just as much importance as the merchants or the manufacturers of the city, and if there is anything that the Board of Trade can do at any time to assist them, we want them to feel free to call upon the Board. The rooms are open every working day in the year, with officers in attendance, to render assistance in the matter of information or help in a business way.

The CHAIR. I now have the pleasure of introducing President Butterfield of the Rhode Island College of Agriculture and the Mechanic Arts.

REMARKS OF PRES. KENYON L. BUTTERFIELD.

Mr. Chairman, ladies and gentlemen: I am very glad to be at this meeting. I was brought up in Michigan, which has been called, as you may know, the western Massachusetts. I don't know whether you people in Massachusetts are proud of that title for Michigan, or not; we in Michigan are not ashamed of it for ourselves. I speak of this because I was brought up to think, from what I had heard my father say and from some early reading that I did on agricultural lines, that Massachusetts in the early days, through its Board of Agriculture and through its Horticultural Society, was not only a pioneer but a leader in developing things agricultural. The records show that away back in the early years of agricultural development Massachusetts men and

Massachusetts institutions not only brought forth ideas, but put them into practice for the benefit of the rural people. And so I feel that I am coming to historic ground from a standpoint of agriculture.

I think that the thought that has been with me most this evening has been the interest that seems to be shown by the citizens of Worcester County. In most cities that I am acquainted with the citizens are inclined to think of agriculture as a thing apart from their own interests. Apparently the citizens of Worcester have seen that agriculture is "related to both of us," not only those interested in the farm and interested in the development of agriculture, but also those who live in the cities, and who can see that the development of the farming community and the agricultural industry are vital to the prosperity of the city. I hope that this impression that has come to me of the unity of interests between the people of the city and the people of the country in Worcester County is a fact. I am impressed with this beautiful hall, a monument to a great society. I have been impressed with the splendid audience gathered under the auspices of the Board of Agriculture; and it seems to me that these things that I have merely suggested are not only expressions of a successful agriculture in this portion of the Commonwealth, but that they augur a greater development for the future.

The Chair. This concludes the literary exercises of the evening.

A collation was then served in the society's dining hall, after which the remainder of the evening was passed in social enjoyment. Instrumental music was furnished during the evening.

THIRD DAY.

The meeting was called to order at 10 A.M. by Secretary Ellsworth, who introduced Mr. Walter D. Ross of Worcester as the presiding officer.

The Chair. It is certainly very pleasant for me, representing the Worcester Agricultural Society, that these meet-

ings the past two days have been so successful, not only in quality of addresses but in the numbers we have had and in the interest that has been taken. I feel very well pleased that the invitation was accepted, and that the Board decided to hold these meetings here in Worcester instead of in some other place.

The question which we have to discuss this forenoon is certainly an interesting one, and I have the pleasure of introducing to you Dr. Chas. D. Woods, director of the Maine Agricultural Experiment Station, who will speak on the subject of "Nitrogen in relation to soil fertility."

NITROGEN IN RELATION TO SOIL FERTILITY.

BY DR. CHAS. D. WOODS, ORONO, ME.

We sometimes think of the practical farmer as a very conservative man, and yet it is only a generation since Stockbridge, Johnson, Goessmann, Atwater and others began to write and teach some of the then very new things that foreign, and particularly German, scientific men were finding out relative to the chemistry of plant nutrition. Many of the founders of the agricultural colleges are still living, and it is only thirty years since the first agricultural experiment station in America began its work. And what a change has been wrought in farm practice and theory!

In the progress which has been made in all these years, the farmer has become so familiar with the chemistry of fertilizers and cattle foods, the demands of plants and the feeding standards for animals, that it has come about that many are using this chemical knowledge as though it were exact, and as though plant growing and cattle feeding were largely questions of arithmetic. For several years research has been going on along other, and in some ways more important, lines than chemistry; with the result that to-day, in a way, the farmer in his practice and his reasonings is as far separated from the advances of science as he was years ago, when the scientific men who first did so much for the agriculture of New England were advancing the chemical theories. It is of course for such purposes that you have established the agricultural experiment stations, and you demand that they shall constantly be working out into the new and unknown; blazing trails which shall later become highways for the followers of practical agriculture. I am

sure that to an audience of Massachusetts farmers I need make no apology if I say some things that lie outside of their usual thinking in connection with soil fertility.

The Chemical Theory of Soil Fertility.

In its broad meaning soil fertility can be defined as the power that a given soil has to produce crops of desirable kinds of plants. Since Liebig's time, and until within a very few years, soil fertility has been supposed to depend chiefly upon the kinds and amounts of plant food that a given soil may contain. This chemical explanation announced by Liebig was for many years closely followed with the result that the chief inquiries into soil fertility were made by chemists along chemical lines; and, as it now seems, undue importance was attached to the chemical compounds contained and the purely chemical changes going on in the soil. It was speedily found that plants as a rule responded only to applications of materials containing nitrogen, phosphoric acid and potash, and to some extent lime; hence it was assumed that plants were readily able to obtain all of the other elements which enter into their growth from the soil, water and air. A generation ago it was believed that a chemical analysis of a soil, showing the amounts of nitrogen, phosphoric acid and potash that it contained, would furnish the needed data for proper manuring. Based upon the chemical theory of soils and plant nutrition, such very helpful books as Johnson's "How crops grow," and "How plants feed" were written. As explained in these and similar books, the whole story of plant growth reduced to bald outline is something as follows: —

A soil is formed from disintegrated rock, broken down by physical and chemical processes called weathering. The soil thus formed was regarded as dead, inert matter, containing plant food material which by chemical action may become available for plant growth. The simpler forms of plants develop first. By their death they add organic matter to the soil, thus fitting it for the higher forms of plant life. This organic matter undergoes certain chemical changes, and is thereby converted into humus. The coarser particles

of a soil (sand), consisting chiefly of quartz, and the finest particles (clay), consisting mostly of silicate of aluminum, carry little or no plant food. Between sand and clay, as regards size, is silt. This is composed of different minerals, varying with the kind of rock from which the soil was made. This usually contains much of the mineral constituents of plants, particularly phosphoric acid, lime and potash. The silt and the humus by chemicai changes were supposed to supply the necessary food for plant growth, and the function of the sand and clay was believed to be chiefly to give a soil proper physical characteristics, so as to allow circulation of air and water. The plant obtains its food materials through the leaves and roots. This food material is of three kinds; water, chemical substances and gas. Water is an actual necessity to plant life, both as a food and food solvent and transporter. The chief chemical substances that affect plant life do not enter into the plant as such, but combined with other substances and dissolved in water. The gases essential to plants are carbonic acid, hydrogen, oxygen and nitrogen. By the action of chlorophyll the leaves absorb carbonic acid from the air. The hydrogen and part of the oxygen is obtained by the decomposition of water: the remainder of the oxygen is obtained from the air of the soil. Both of these gases are received through the roots. Nitrogen can probably be used only in the form of a nitrate, and it is taken up through the roots. Very little soil nitrogen is in the form of nitrate, and what little there is, is subject to loss. By chemical action the soil nitrogen is oxidized to nitrate. But for the most part the supply of nitrate nitrogen must be kept up by applying it directly as nitrate, or as ammonia, or as organic nitrogen, in farm manures and other materials. In the two last instances the nitrogen was supposed to be changed by chemical forces into nitrate nitrogen, and thus made available to the growing plant.

Limitation of the Chemical Explanation.

This chemical theory explained the action of mineral fertilizers, including nitrate nitrogen; and, founded upon this theory, elaborate field experiments with fertilizing materials

brought results of great practical importance. When it is considered that the whole commercial fertilizer industry, involving thousands of pounds of plant food, worth millions of dollars, rests upon this theory; that the business is of such importance that fertilizers are sold under close police regulations, based upon chemical analyses, — one comprehends how sweeping these generalizations are, and how they have entered into practical agriculture.

This explanation is so simple and seemed so rational that it is a thousand pities that it will not account for all of the phenomena. It seems to serve better for everything else than for nitrogen. Even Liebig saw that he could not satisfactorily account for this element by known facts; but he and his successors confidently expected that new chemical facts would be found that would explain and correlate the peculiar facts observed about this element.

Plant Food not All Available.

Chemical analysis of the soils, however, showed that even the meanest soil contained enough of nitrogen, phosphoric acid and potash to grow many crops. As ordinary soils would not produce such crops, this plant food was supposed to be unavailable, but that in some way, by exposure to the air, to water, etc., this unavailable plant food would by chemical changes become available. That no known method of soil analysis would indicate the fertility of soils was soon learned; and the so-called soil tests with fertilizers were introduced, so as to overcome the limitations of the chemist's knowledge, and put the "question directly to the soil itself."

The inadequacy of the chemical method of the soil test is shown by the fact that, while the top foot of a good soil carries more than 3,500 pounds of nitrogen per acre, and a crop of potatoes removes not more than 75 pounds of nitrogen in tubers and tops, it is frequently necessary to supply more than that amount of nitrogen in a fertilizer in order to obtain a crop. It is much the same as though a man had $3,500 on deposit in a bank, but before he could have his draft for $75 honored he must make an additional deposit of perhaps $150.

Importance of Soil Physics.

This chemical explanation of soil fertility is very generally accepted by practical farmers and by fertilizer manufacturers. Stockbridge, Johnson and others, by writings, lectures and field work, were spreading the results of investigations along this line almost a generation ago. But even then they saw the difficulties in the way of a complete explanation of soil fertility by chemistry alone. While chemistry is still the most important component of agricultural science, and without the explanations it brings agricultural knowledge would be unclassified, if not chaotic, the newer findings of soil physics and soil bacteriology are needed to supplement practice in conserving and increasing soil fertility. The facts that are being brought out by these new sciences cannot as yet be said to have replaced, and perhaps are not likely to replace, the old chemical outlook, but they are supplementing where they do not supplant. Soil science is at present in a more or less transitory stage. While it is not possible to affirm with the positiveness of twenty-five years ago with regard to the fundamentals of soil science and practice, there are some things that have been learned; and if our practice is to keep pace with new knowledge, we must be alive to all that these new classes of facts mean.

The Soil not a Dead Thing.

The profoundest change that has come about — and it has come so gradually that we have not all really recognized it — is the fact that soil, instead of being a dead, inert thing, holding dead plant food to be assimilated and made alive by growing plants, is teeming with life. It is now recognized that the soil is not a chemical laboratory, and that it is not merely made up of a number of independent chemical substances in various stages of hardness and solubility. Instead of being an inert physical mass, the soil is in reality full of germ life. While the knowledge of soil bacteria has not advanced to the point that positive deductions can be drawn in other than a limited and perhaps tentative way, still, the results are so important in their bearing upon the

nitrogen of the soil and plants that they must be taken into account in deciding upon any rational plan of soil management.

Nitrogen and Crops.

Experiments and experience have shown that nitrogen is the most important food material required by plants. It has, however, been demonstrated that a plant cannot acquire nitrogen by absorption through the leaves, nor can the plant take uncombined nitrogen through its roots; and yet a plant would perish unless nitrogen existed in some combined form in the soil, and in a state readily obtainable by means of its roots. Experience has, on the other hand, shown us that, though nitrogen is such an important factor and so difficult to obtain by plants, yet there are a number of cultivated plants that obtain it somehow, and that when grown in a rotation or otherwise they leave the land in a better condition in respect to nitrogen content than before.

The cereals, — wheat, rye, oats, barley and corn, — the roots and the tubers have long been noted as nitrogen consuming, because they draw large amounts of nitrogen from the soil, leaving it poor and worn out after repeated croppings. It has been found that these plants practically suffer from starvation when the soil does not contain sufficient supply of available nitrogen, and that this lack of plant food must be supplied artificially in order to grow crops of such plants.

On the other hand, certain plants, such as peas, beans, vetches and clover have been found not to respond to application of nitrogenous manures, yet apparently are able to obtain nitrogen by some natural means. While this class of plants contains a large amount of nitrogen, in some way they actually increase the amount of nitrogen in the soil. It was the study of this class of plants, which will be referred to later, that first brought into prominence the germ life in the soil.

Soil Bacteria.

It is only within the past twenty years that bacteriology as a science has made its marvellous advance. The word bacteria, which was practically unknown a quarter of a

century ago, is now a common household word. We, of course, used bacteria abundantly in the past, but it is only recently that we were aware that we were doing so. We now know that the common processes, such as bread making, brewing, making vinegar, ripening of cream, the developing of flavor in cheese, and hundreds of other every-day matters, are dependent upon bacteria or other very low forms of life. Through bacteriological research it has been found that the soil is filled with micro-organic life, so that there may be from 100 to 200 millions of germs present in a single ounce of soil.

While as yet we know but little of this soil life, sufficient progress has been made so that certain bacteria, particularly in their relations to nitrogen, may be classified. While it is possible that the relations of the bacteria are as important to sulphur, phosphorus and other mineral constituents, the problem of the nitrogen transformations are probably far more significant to the fertility of the soil. Because of the rapid loss of nitrogen from the soil under faulty management, it is more important for us to acquaint ourselves with the results of bacterial action upon nitrogen and its various compounds than upon other soil and plant constituents.

Kinds of Bacteria.

This is not the place nor is there time to enter into a discussion of the nature of bacteria and their natural history, but a few points must be noted in order to guide our practice in the handling of soils and manures. Not only are there millions of bacteria in an ounce of soil, but there are very many kinds of bacteria. Not all of these by any means have been isolated, and of many of those that have been separately studied little is known as to what they do.

Some bacteria live without oxygen (air); others can live only with an abundant supply of oxygen. Some bacteria are parasitic, living within and feeding upon the tissues of animals or plants; others use the dead tissues of plants or animals for their food, thereby breaking complex chemical compounds into much simpler ones; and still others build up complex compounds out of simpler ones. All of these different kinds of bacteria are concerned in the nitrogen

transformations that are going on in soils and manures; and to add somewhat to the complexity of the problem, many of these changes involve more than one kind of bacteria, and many different kinds of transformations may be in progress at the same time in the soil, the manure pile or compost heap.

Changes due to Bacteria.

The decomposition bacteria are those which produce decay and putrefaction. Decay takes place in the presence of plenty of oxygen; putrefaction occurs in its absence. The decomposition bacteria occur practically everywhere in nature. They are so widely distributed and are so abundant that they are sure to find any dead nitrogenous organic matter which can serve them as food. With such food supply they multiply with exceeding rapidity until they have used up the food material, thereby breaking it up into very simple compounds, such as water, carbonic acid, ammonia, etc. Their growth is then checked, and those remaining lie in the soil ready to grow again when more organic matter comes within their reach.

Another class of bacteria takes the ammonia that the decomposition bacteria have formed from the proteids of dead animals or plants, and under suitable conditions change it over into nitric acid (nitrate nitrogen), which is in the form in which plants can use nitrogen as food. Still other bacteria, under proper conditions, may change this nitrate nitrogen over to nitrite nitrogen, which is a form that puts it out of the reach of plants; and still another kind of bacteria may, if the conditions are right, take this nitrite nitrogen and convert it into free nitrogen, and it will then escape into the air and be lost to agriculture.

There is still another class of bacteria, that will under suitable conditions take the free nitrogen of the air, and out of it build, either directly or in company with other kinds of bacteria and plants, compounds of nitrogen that plants can use for food. The most important, apparently, and certainly the ones we know most about, work in or upon the roots of such plants as peas, clover and other legumes, and enable them to acquire from the air free nitrogen that otherwise is out of their reach.

Soil Nitrogen and its Availability.

The examination of 49 samples of American soil showed them to carry in the first 8 inches from 640 to 10,000 pounds of nitrogen per acre, and the subsoil carried from 1,800 to 6,200 pounds. This amount of nitrogen equals that removed by 15 to 100 large annual crops of any farm plant. Only a small percentage of this nitrogen is in such form that it is available to plants. Can it be rendered available?

Before the nature of the change which takes place in the soil was understood, it was known that certain conditions were favorable for changing soil nitrogen into the form of nitrate. Samples of Manitoba soils which carried about 7,000 pounds of total nitrogen per acre were kept for 300 days under favorable conditions for nitrification, and from these experiments it was estimated that not less than 800 pounds per acre were converted into soluble nitrates which would be available for crop production. While the conditions under which these samples were placed for nitrification were perhaps more favorable to the rapid carrying forward of the process than could be produced in the field, it is not to be inferred that the amount so changed represents the total nitrogen in these soils that could be rendered available. There seems to be no reason why, with time and favorable conditions, practically all that which analysis shows a soil to contain could not thus be converted into a soluble form.

From the bacterial considerations which we have been studying, it follows that one of the primary conditions for the transformation of nitrogen is the presence of proper bacteria in the soil and proper conditions for their growth. It is a practical question to learn how these bacteria being not already present may be added to the soil, and how they may be stimulated in activity if they are present. Bacteriologists are strenuously applying themselves to the solutions of these questions, and, although the answer is as yet incomplete, some facts of high significance have already been established.

Nitrification.

Most soils have the nitrifying bacteria already present, so that a stimulation of their action is needed, rather than the addition of more bacteria of the same kind. If it is necessary to supply more of the nitrifying bacteria, this can be readily done by the use of farm manure, which contains them in abundance. The question, therefore, of the greatest importance is how the nitrifying bacteria in a soil can be stimulated so as to act upon the store of organic nitrogen which is contained in the humus. For the favorable growth of these bacteria the soil should be neither too dry nor should it be saturated with water. Nitrification begins to take place at a temperature of about 37° F., and becomes more vigorous as the temperature rises. It therefore ceases with us in the winter and is most vigorous in midsummer. Nitrification will not proceed in an acid soil; hence it frequently happens that the addition of even a small amount of lime has a wonderful effect, — far more than can be attributed to the fertilizing value of the lime itself. For the same reason the addition of a small amount of manure to a soil frequently produces results far beyond the fertilizing value of the manure. In the first place, the manure is sure to be alkaline, which may be sufficient to neutralize the acidity of the soil; and it also adds large numbers of the nitrifying bacteria to the soils.

Another most important thing that has been found is, that the nitrifying bacteria require large supplies of oxygen, and nitrification is therefore stimulated by anything which tends to add more air to the soil. This points to and partly explains the value of thorough cultivation. Merely the stirring up of a soil will materially add to its available nitrogen, even without the addition of any plant food. Experience has shown that the more thorough the cultivation the greater is the nitrification and the larger the crops. This also explains why the process of fallowing, which was formerly practised, is not a good one. Fallow land is worse than wasted, for the nitrification not only is relatively reduced, but, there being no plants to take care of what little is

formed, there is great danger of its being lost in the drainage waters. Because nitrification goes on faster at the higher temperatures, it follows that in the early spring, while the land is still cold, nitrate nitrogen is much less abundant than in midsummer, after the soil is warmed up. As the nitrates which are formed are in great danger of being lost if not speedily taken up by plants, it is important to keep the land at all times covered with growing plants. One of the factors of continued soil fertility is therefore continued soil cultivation and continued growing of plants upon the lands.

The Maintenance of Soil Nitrogen.

Every growing crop removes very considerable quantities of nitrogen. The nitrates which are formed in the soil are in danger of being leached out by drainage waters, or being broken up into free nitrogen by the denitrifying organisms. All of this is a constant drain on the land, and means a loss of soil nitrogen. These facts have been known for many years, and until recently there has been no satisfactory answer to the question, "Is it possible to maintain the supply of soil nitrogen?" The amounts of nitrogen brought to the soil in the form of nitric acid and ammonia in rain are small, and are totally inadequate to meet the demands of growing crops.

To replace the nitrogen removed by crops, men looked about for sources of available nitrogen stored in the earth. Large quantities of guano, found on islands which for generations had been the breeding places of sea fowl, were used until this store was exhausted. Then came the discovery of enormous beds of nitrate of soda in South America, and this nitrate of soda is still being used extensively for our agriculture. Like the guano, these beds will some time be exhausted. Can we turn elsewhere with surety? This brings us to consider one of the most important discoveries of modern times.

Acquisition of Atmospheric Nitrogen.

Prior to 1880 large numbers of pot experiments had apparently shown that plants could not acquire nitrogen from the air. Experiments made by Dr. Atwater and the speaker in 1880–81 and confirmed in 1882 showed conclusively that the pea plant had in some way the ability, when grown in sand entirely freed from nitrogen compounds and watered with specially prepared distilled water which contained no nitrogen, to flourish. Under such conditions they grew to maturity, and the plants were found to contain many times as much nitrogen as there was in the original peas used as seed. Other experimenters explained the how of this, so that for the past twenty years it has been common knowledge that the legumes — peas, beans, clover, alfalfa, etc. — have the power of acquiring atmospheric nitrogen through enlargements upon the roots, called root tubercles or nodules, which are caused by bacteria.

Nitrogen Fixation and Following Crops.

The actual benefit of the presence of root nodules has not only been thoroughly worked out in pot and box experiments, but in field culture on a large scale. A convincing demonstration of the effect upon a soil of a leguminous crop bearing abundant root nodules is to note the striking differences between crops of cereals or vegetables following legumes, and those following a grass (without clover) or vegetables. This has come to be such a matter of everyday knowledge that no thinking man would plan a rotation that did not include at least one leguminous crop. The results of a large number of experiments by American experiment stations show that at least 120 pounds per acre of nitrogen may be added by a leguminous crop. This is equal to a dressing of 800 pounds of high-grade nitrate of soda.

Soil Inoculation.

In the early pot experiments it was found that, by shaking up a soil in water and applying a little of the clear solution to a sterile soil, it could be thus inoculated. For many

years it has been known that applications to other land of those soils in which root tubercles are produced would cause these tubercles to grow on legumes where they would not previous to such inoculation; that is, it is possible by soil inoculation to have the proper organisms put into a soil where they do not exist. Acting along these lines, ten or twelve years ago German investigators prepared and placed on the market, under the name of "nitragin," pure cultures of the different kinds of bacteria for inoculating soils for different legumes. As a scientific curiosity, nitragin was of great interest, but in practice it oftener failed to yield satisfactory results than to give them. The principles underlying the use of nitragin, however, are of great practical importance; and it was for this reason that the Bureau of Plant Industry of the United States Department of Agriculture undertook a scientific investigation of the root nodule organism and soil inoculation. The results of their investigations are given in Bulletin No. 71 of that Bureau, and in Farmers' Bulletin No. 214 of the United States Department of Agriculture. The discussion which follows is based largely upon these publications.

Nature of Root Nodules and Conditions favorable to their Growth.

The organisms that produce root nodules may properly be regarded as bacteria. They gain admission to the plant through the root hairs, and rapidly increase in numbers. The irritation thus caused in the root tissues usually results in the formation of an enlargement of the root nodule. These vary greatly in size and numbers. Although it is probable that the bacteria which produce these nodules are in different legumes of one kind, it is nevertheless usually necessary for speedy and successful soil and plant inoculation that the bacteria used be obtained from the same kind of legume that it is desired to grow. That is, it is necessary, in order to obtain the best results, to prepare specific cultures for specific crops. The amount of moisture in a soil has a marked effect upon the growth of root nodules, a

moist soil being far better than a dry one. The organisms must have air, or they soon die; hence the importance of thorough working of the soil, both to admit air and conserve soil moisture. Direct sunlight is fatal to the cultures, but probably has no effect after they are introduced into the soil. Soil acidity is unfavorable to the growth of these organisms; hence the addition of lime or ashes to a soil is an advantage, and is often a necessity for the formation of root nodules. In experiments at the Maine station it has been found difficult to grow root nodules upon alfalfa, without the use of very considerable quantities of lime or ashes, on soils that grow clover or peas luxuriantly and with abundant nodules. This would seem to indicate the possibility of these organisms adapting themselves to different conditions as regards soil as well as host plants.

Department of Agriculture Cultures.

The failure of nitragin can be attributed to the method of growing and keeping the cultures. It was found that when grown with an abundance of nitrogen the bacteria speedily lost the power of acquiring nitrogen. At the Department of Agriculture the cultures are grown in media that contain no nitrogen, and the claim is made that thus grown the bacteria have increased virulence over the original stock. Nitragin was sent out in liquid form. The department prepared dry cultures for shipment. They saturate absorbent cotton in a liquid culture of the nodule-forming organism, and then carefully dry the cotton. In this way millions of bacteria are held within a very small amount of cotton, and they remain dormant, much as seeds, waiting for the proper conditions to revive them. For use this dry culture is immersed in water, to which proper chemicals (sugar, magnesium sulphate and potassium phosphate) have been added for food. After they have grown for twenty-four hours in this solution, a little ammonium phosphate is added to still further increase the growth. The process has been patented by the department, but no restriction is placed upon the manufacture of cultures by these methods, provided they

are properly made and sold at a moderate price. Unfortunately, as discussed later in this paper, the cultures thus prepared cannot always be depended upon.

When is Soil Inoculation necessary or desirable?

Whether the farmer needs to inoculate his soil depends upon many things. According to the department publications above referred to, these may be summed up as follows. Inoculation is necessary when the land has previously borne no legumes, or when the legumes have not borne root nodules. It is desirable, and may be necessary, when legumes of another group are to be grown. Alfalfa may fail to develop root nodules when grown on land that produces clover root nodules in abundance. It is also desirable to inoculate the soil when legumes make a sickly growth, even though their roots bear nodules. On the other hand, inoculation is unnecessary where the leguminous crops give good average yields and are well supplied with root nodules. There would also be no use in using cultures on soils that carry large amounts of available nitrogen, for on such soils legumes use the combined nitrogen, even though they are provided with root nodules. Inoculation is worthy of trial wherever the crop of legumes is not producing the best of yields.

According to the department publications, soil inoculation will fail when the directions for the preparation of the solutions are not followed; when the ground is already inoculated; when the soil is too rich in nitrogen, or when it is too acid or too alkaline, and when it is deficient in mineral plant food. In order to obtain benefits from soil inoculation, the farmer must inform himself upon the general culture of the crop that is to be grown. To do otherwise is to invite failure.

There is nothing magical about soil inoculation. It will not produce a crop unless other conditions are strictly complied with. Thorough preparation of land, proper mineral fertilizers, thorough preparation of the seed bed, clean culture and all other things that attend successful agriculture are as essential when cultures are used as when they are

not. To any one that has not been successful in legume growing, soil inoculation may solve the problem. That much profit will come to the average New England farmer from inoculation with such crops as clover and peas that have been so long grown that most land is abundantly supplied with the proper organisms, is not to be expected.

WILL SOIL INOCULATION PAY?

The Department of Agriculture carried on with practical farmers all over the country about 3,500 experiments with cultures. Seventy-nine out of each 100 were regarded by both the experimenter and the department as successful. According to the department publications, there are various reasons which explain the lack of success with quite a part of the 21 that were unsuccessful out of each 100.

The Maine station has experimented in the use of inoculated seed and cultures on alfalfa, clover and peas. In the case of the alfalfa, the seed was inoculated at the department prior to its being sent to the experiment station. The results with alfalfa, while not uniform, were in favor of the inoculated seed.

During the past twenty years the speaker has frequently pulled up clover plants to look for root nodules, and he has never found a clover plant in New England that was not well provided with nodules. It is therefore not surprising that the results of experiments in Maine soils, already provided with an abundance of organisms able to form root nodules on clover in somewhat acid soil, have not shown benefit from the use of cultures.

During the past season experiments were made, on land cleared from the original forest, with peas, part of which were inoculated with cultures and part not. The season was a phenomenally dry one in the locality in which the experiments were carried out, and no decisive results were obtained.

Unfortunately, the cultures sent out in 1905 by the Department of Agriculture as well as by the commercial companies have proven unsatisfactory. Only a small percentage of the cultures sent out, so far as they were examined by bacteriologists, carried the proper organisms. Cultures

made in accordance with the directions accompanying the packages carried, as would naturally be expected, a large amount of foreign bacteria and yeasts and other low plant organisms, but in many instances they had no root tubercle organisms. Of course the use of such cultures could give only negative results. That this method of preparing and shipping cultures proved to be so unreliable in 1905, is greatly to be regretted. This matter has been fully investigated by the New York State Agricultural Experiment Station, and the results are now in type and will be ready for distribution in bulletin form in the near future.

As I understand it, the New York investigations show that the principle of soil inoculation from cultures is all right, but that the method of preparation and shipment practised by the department and the commercial companies cannot be depended upon for soil inoculation. Fortunately, as stated above, on most New England soils there is probably nothing to be gained by the inoculating for our common leguminous crops, such as clover, peas and beans. If one desires to grow alfalfa or soy beans, cow peas or other leguminous plants that are not commonly grown in New England, there seems to be only one of two ways in which they can be inoculated with any surety at present. That which is to be most depended upon is the application of soil, at the rate of perhaps half a ton to the acre, taken from fields that have grown the required legume with an abundance of root tubercles. It would also be possible to have a bacteriologist prepare cultures in the liquid form from root tubercles growing on the desired kind of plants. This last method, while being theoretically possible, is practically beyond the reach of most people.

The inventor of the cotton method, Dr. Moore, is now in the employ of one of the commercial companies, and it may be that they will be able to overcome the difficulties that caused the failures in 1905. According to the Chief of the Bureau of Plant Industry of the United States Department of Agriculture, these failures in 1905 are attributed to the dried inoculated cotton absorbing moisture from the air, which seemed to prove fatal to the bacteria.

Decomposition of Manure.

The freshly voided manure of animals contains an enormous number of many varieties of bacteria which act upon the nitrogen compounds. These are very active in breaking down the complex materials left in the processes of digestion, and changing the nitrogenous materials into forms available to growing plants. Hence it happens that in the manure heap the organic compounds are being very rapidly broken up. The nitrogen compounds are changed partly into free nitrogen, which is lost, and partly into ammonia. This change to ammonia is very noticeable, and frequently, because of the rapidity of the fermentation, the small amount of acid developed is not sufficient to retain the ammonia, and the very familiar odor of ammonia escaping from the manure heap results. It is of course important that these destructive changes be controlled so far as practicable, and the resulting ammonia preserved. The most obvious chemical treatment would be to sprinkle the manure heap with an acid. This results in fixing the ammonia and restraining the action of the bacteria. Sulphuric acid has been frequently employed for this purpose, but the method is somewhat expensive both in material and labor. Chemicals, such as acid phosphate, land plaster, kainit, muriate of potash, etc., have been used with more or less success. In the case of the acid phosphate and the potash salts, the phosphoric acid and potash which these materials carry will of course be available for the growth of plants when the manure is applied to land. It is doubtful, however, if these materials can be advantageously applied, except perhaps in the handling of hen dung.

In addition to the destructive bacteria, there are the constructive ones, which nitrify the ammonia so as to make it available for plants. Apparently this nitrification does not begin until the organic nitrogen has been almost wholly broken up into ammonia, and this ammonia is either united with acids or has been lost in the air. The nitric bacteria are so extremely sensitive to ammonia that they cannot begin to form nitric acid until ammonia gas has entirely disap-

peared. As this process continues, the manure heap is more and more filled with nitrates, and therefore becomes a better and better food for plants. When put upon the soil it furnishes the soil both with plant food and with great quantities of the nitric bacteria, which may be of practical value in the soil in converting its nitrogen into available form.

Methods of Handling Manure.

While in the handling of the voidings of neat stock and horses it is probably not advantageous to use chemicals for the preservation of the manure, the manure can be mechanically treated so as to be helpful. For instance, the loss of nitrogen appears to be greater in manure when there is a perfectly free access of air than when it is compactly massed; hence it is wise to keep the manure in compact heaps, and the more compact the slower the fermentations and the less danger from losses. This explains and justifies the practice, so common in New England, of compactly storing manure upon tight floors in barn cellars. Not only does this avoid loss from leaching and make it possible to save the urine, but it helps control the fermentation. It is also quite common to allow hogs to run upon this manure, and it is thus made more compact. The exclusion of air thus brought about checks the rapidity of bacterial action. Unless precautions of this kind are taken, it probably would be better to keep, where practicable, the liquid manure separate from the solid, because the urea decomposes much more quickly than does the solid excrement.

Of course the same changes go on, whether the manure is in heaps or whether the fresh manure is put upon the soil. The results of many experiments seem to indicate that there may be a greater saving in the nitrogenous parts of the manure if it is freshly applied than if it is allowed to ferment before being put upon the land. Experiments upon the different methods of storing show there was less loss of nitrogen when the manure was exposed to the air in heaps than when it was put in heaps under a shed; but in this particular experiment the shed was drafty, and this may account for the greater loss. There was the largest loss when

exposed to the air in thin layers, which would seem to indicate the desirability of getting the applied manure under the ground as speedily as practicable, to avoid the loss from washings by rain as well as from the fermentations, which proceed very rapidly under these conditions. It is not advantageous to have nitric nitrogen formed a great while before the manure is to be used, because of the danger that denitrifying bacteria will break up this nitric acid into free nitrogen, and it be lost to plant life. This is another advantage in keeping the manure compact in a heap before it is to be used.

The Value of Farm Manure.

The application of farm manures is advantageous from two wholly different reasons. They carry considerable quantities of plant food, particularly nitrogen. This is the chemical side, which has been in the past perhaps unduly emphasized. There is another equal and in some cases greater advantage derived from the application of farm manures, because of the large amount of nitrifying bacteria which they carry to the soil.

It seems, from all of these considerations, that the twentieth century farmers before the century is far advanced may come to place as much dependence upon bacteria and the fermentations which they produce, both in manure and in soil, as upon the stores of plant food which the manure and the soils contain.

Summary.

I have tried, in this somewhat hurried way, to outline some of the changes that are going on in the knowledge of the soil fertility in its relation to the supply of nitrogen. I thank you for the patient hearing which you have given to these somewhat dry, and I was about to add uninteresting, facts. But the facts are not uninteresting. I wish I was as sure as to the way they have been presented. In closing, I wish to attempt to indicate some of the ways in which these facts can be utilized in practice. Much is yet unknown on this subject, and no hard-and-fast statements can be made.

To utilize the Nitrogen of the Soil.

In order for soil nitrogen to be transformed into an available form, the proper kinds of bacteria must be present, and the conditions for their growth must be favorable.

An abundant supply of oxygen is essential to bacterial growth, and this can be obtained by plowing and the thorough working of the soil, particularly during the growing season.

For the best growth of bacteria the land should be neither dry nor wet. The proper moisture conditions in the case of land not naturally well drained can be improved by artificial drainage. Tile drains are best, and in the end the cheapest.

Bacteria grow best in warm soil. The removal of surplus water by drainage, frequent tillage and a roughened surface tend to warmth of soil. Dark-colored soil will warm faster in the sun than light-colored; but, as it cools off faster in the night, dark soil does not warm up so much more rapidly as one might at first think.

If the land is not well stocked with the proper bacteria, the application of farm manure will usually give returns far greater than can be measured by the plant food it carries. As has been pointed out, farm manure, either fresh or ripened, is well stocked with bacteria, among which there will always be large numbers of the proper organisms for transforming the nitrogen into available form. The addition of manure is often of great benefit to recently drained swampy land, which will usually be deficient in nitrogen transforming bacteria.

Bacteria do not work well in the presence of acid; hence the addition of even a small amount of lime to the field may greatly hasten nitrogen transformation. This explains in many instances the beneficial effect of applications of lime to recently drained land that was rather wet before drainage.

Nitrate nitrogen is very readily lost in a variety of ways from the soil. The surest way to prevent loss is to have plants growing upon the land all of the time during the growing season. The old practice of allowing land to lie

fallow should never be practised from the standpoint of the nitrogen supply. The aim should be to practise thorough and frequent cultivation, and always keep a crop growing on the land. This is even more important in the summer and fall than in the first of the season.

Handling and Value of Farm Manure.

As has been already stated, the value of farm manure is frequently greater because of the bacteria it supplies to the soil than because of the plant food it carries.

There is less loss of nitrogen if the manure is applied about as soon as dropped by the animals, provided it can be at once worked into the soil.

Storing in compact and well-moistened piles retards fermentation and reduces loss of nitrogen.

The addition of litter, as straw, etc., tends to allow access of air, and also supplies organic matter for the use of the bacteria as food. Such additions hasten the decomposition, increase the danger of loss of nitrogen and are usually not to be recommended. For the same reason, it is better not to mix horse manure with that from neat stock.

Where practicable, it is better not to mix the urine with the solid manure, because it ferments more rapidly and increases the danger of loss of nitrogen.

Nitrate of soda should never be mixed with farm manure, as the bacteria may break it up; and the nitrogen, if set free, will escape into the air and be lost.

Well-rotted farm manure is rich in nitrates, and should be applied at such times that the loss from leaching will be at a minimum, and to quick-growing crops that will speedily use this very elusive but essential form of nitrogen.

In order to get the best effect from manure, it should, whether applied fresh or rotted, be evenly spread. Putting small piles in the field and spreading from these is a bad practice. Even if the piles are not allowed to remain long before spreading, the manure will be very unevenly distributed. Even if a manure spreader is not used, it can be better distributed by shovel from the cart than from the ground.

Farm manure should not be used in growing a crop of legumes, as with an abundance of available nitrogen they will make use of this and not acquire nitrogen from the air.

The addition to the manure heap of acids to fix the ammonia, and chemicals, such as kainit, acid phosphate, etc., will delay fermentation and prevent loss of nitrogen to a considerable extent. With the exception of hen manure, it is doubtful if such treatment will in most cases prove economical.

The same general remarks apply to compost heaps and to composting as to handling manures. There is a very decided advantage to the fermentation if the materials in the compost are frequently shovelled over and well mixed.

The amount of compactness desirable will depend upon the nature of the materials being composted. If fermentation is not proceeding with sufficient rapidity in the compost heap, the addition of manure will hasten it, because of the bacteria thus introduced into the compost. If it is proceeding too rapidly, making the pile more compact or wetting the pile will diminish the rapidity of fermentation.

Addition of Nitrogen to the Soil.

In the early spring there will be but little nitrate nitrogen present in the soil. That formed the preceding season will, if it has not been taken up by growing plants, be apt to be either lost in the drainage waters or carried to such depths that the roots of the small plants cannot reach it. Hence in the early spring applications of even small amounts, 50 to 100 pounds per acre, of nitrate of soda, will usually prove profitable on all crops, with perhaps the exception of the legumes, — peas, beans, clover, etc. If used in connection with farm manures, it should be applied separately and not mixed with the manure. This will reduce the chance of loss of the nitrate by the action of decomposing bacteria.

The way to obtain nitrogen for the soil that must come more and more into practice is by growing leguminous crops. Clover, peas, beans, vetch and allied plants, which have the power, by aid of the bacteria which form root tubercles, of acquiring atmospheric nitrogen, will assume

in the future much more prominence than in the past. No rotation on the farm should be planned which does not include one or more crops of this family of plants.

If the proper organisms are not present in the soil, or if the root tubercles formed are not large and vigorous, the soil must be inoculated with the proper organism, in order to take advantage of the property of leguminous crops of acquiring atmospheric nitrogen. The announcement given out by the United States Department of Agriculture, that they had discovered a process whereby cultures containing the proper organisms could be readily distributed in the dry state, seems to have been premature. While experiments with the cultures sent directly from the department prior to 1905 seem to have been successful, the cultures of the department and of the commercial companies were not reliable in 1905. While experimenters are still at work upon this problem, and there is every reason to hope for the ultimate success, one cannot at present depend upon the artificial cultures either of the department or of the commercial companies for the inoculation of soil. There will be no difficulty in New England in obtaining sufficient soil from near-by fields to inoculate such plants as clover, peas and beans. If it is desired to grow alfalfa or other leguminous plants not commonly grown in this section, recourse must be had to applying soil obtained, usually at a distance, from fields that grow the desired kind of plant with an abundance of root tubercles.

In growing legumes when the proper organism is present in the soil, nitrogenous fertilizers should not be applied. Phosphoric acid and potash should as a rule be supplied quite liberally.

As most beneficial bacteria do not grow in an acid soil, the addition of lime is often very helpful in growing clover on clover-sick soil. The experiments at the Rhode Island Agricultural Experiment Station show that lime is frequently of great benefit on soils that are usually not considered in need of lime. It is so cheaply and readily applied that one not having success in growing legumes should apply it, at least experimentally.

The importance of a rotation of crops for Massachusetts farmers cannot be too strongly insisted upon. At least one crop, and if the rotation extends over a period of five years, two crops, in the rotation should be a legume. Whenever the hay grown is to be fed on the farm, mammoth red or alsike clover should be used in the seed mixture. If the land will not grow clover, everything should be done to assist this crop, such as using lime if the soil is acid, and inoculating the soil with the bacteria that form root nodules on clover.

Mr. Augustus Pratt (of North Middleborough). What variety of clover will be best for me to apply to some fields on which I now have a rye crop? It has been my usual custom in the spring of the year to put my harrow on and put on the western clover seed, which I buy in the market under that name. Is there any better clover seed for me to apply than that? Will it be worth while for me to apply any of these that are considered a little doubtful in the New England climate? I have no difficulty in growing clover.

Dr. Woods. You will have to depend upon the clover seed which comes from the great centres, and Chicago is the great centre of the country. I should get from them a seed that is plump and heavy, one that they will class very high. You would naturally think "prime" seed ought to be all right, but prime is the fourth grade of seeds, so you will have to go considerably higher to get the seed you want. Both the dealers and the farmers are a little ignorant about the quality of the seed. With a difference in price of two or three cents a pound, perhaps 99 out of 100 farmers will take the lower priced, although in 999 out of 1,000 cases they ought to take the higher one, because it will on the whole, be a more economical seed. Choose the mammoth clover or the red clover. Crimson clover is an annual, and is hardly sure in our winters. It grows one season and blossoms, but if you sow it in August it will come up the next spring and will bloom some time in June, and then you will get a crop, and that is the end of it.

Mr. Pratt. Some two years ago in the fall I seeded down a piece of red-top and timothy, and had a very good catch; had an excellent crop of red-top and timothy the following season, and cut it off. This present season I have cut two heavy crops of clover; the third I left. I have not applied clover seed to it at any time, and it is a very surprising fact to me that the timothy was all gone and the heavy crop of clover came early in this last season, and after cutting that off there followed a very heavy second crop.

Dr. Woods. In some way there must have been a seeding of clover naturally, or the seed had some clover in it. The first-year clover isn't very conspicuous, particularly where you have a very heavy growth of timothy; and I suspect, if after haying you had looked down into the stubble, you would have found clover all through it, and that later it came on and got the upper hand of the grasses.

Mr. Pratt. In regard to these rye fields, my custom is to put on the smoothing harrow and go over it once or twice, so as to lighten up the soil, and then sow on the seed. What fertilizer would you advise me to apply in order to help both the rye crop and the clover crop?

Dr. Woods. Of course you are fertilizing two different kinds of crop there. For the clover alone you would want no nitrogen, and would want an abundance of phosphoric acid and potash. You would also need for your rye some nitrogen. I should say let the rye take care of itself, and then put on a mineral fertilizer, 400 pounds of acid phosphate and 200 pounds of muriate of potash to the acre.

Question. What per cent of the manure is lost by hauling it out and leaving it on the ground in small heaps, not spreading it until spring? How much more loss than in leaving it in the open cellar till spring?

Dr. Woods. There have been only one or two series of experiments made on that line, and I don't regard them as thoroughly satisfactory; based on them, 20 per cent loss.

Question. How much more if the manure was spread on frozen ground in the fall?

Dr. Woods. That would depend altogether on how fast the fermentation went on. The rain will come down, and part of it will be lost in the surface drainage. If it is on land that is open and not frozen, it will go down in, and if it doesn't go too deep it is there ready for the growing plants. Nitrogen is very elusive, and under some conditions I would not like to have the manure on the ground or on the snow. Then, on the other hand, it sometimes is cheaper for a man to waste nitrogen than it is to waste labor.

Question. You seem to convey the idea that we lose about all the nitrogen if we fall-dress on grass land.

Dr. Woods. Oh, no, sir; I wouldn't want to give that idea at all, because we usually get it onto our grass lands before the ground freezes; or we may get it on so late that it freezes right up and lies there perfectly dormant until spring, when the frost comes out. It doesn't all get away, by any means.

Question. I gather you would recommend using about 150 pounds of nitrate to the acre?

Dr. Woods. On ordinary grass lands. If you had a large amount of clover, you would have to decide whether you wanted to develop your clover; and if you wanted to get free nitrogen from the air, you shouldn't use very much nitrate. With the grasses I think nitrate will pay every time.

Mr. Pratt. I put my top-dressing on with the manure spreader, and on one field which I top-dressed I had very good results. The manure was the same, taken from the same stable. On the other field, I don't know why, but I got no larger crop than I did the year before, and it seemed to me that I lost my dressing entirely. One piece was lower than the other. The lower piece of ground gave me the best results. Is there any estimate how much we lose by top-dressing, instead of putting it onto the soil and working it in?

Dr. Woods. No, sir; I don't know that there are any definite figures for that.

Mr. J. F. Burt (of Easthampton). When I was a young man I thought I knew all about the manure question; and

later on I listened to Professor Sanborn up in New Hampshire, who says we must spread on our manure any time we have time, in which case we don't lose any of it. Then it seems there is another matter. I thought I was doing a fine thing when I mixed my horse manure with the other manure, and let it go down into the barn cellar. I have even bought quite a good deal of horse manure and put it in, and put the hogs on it. Now, that is all wrong.

Dr. Woods. Perhaps not. While the addition of the horse manure will tend to increase the nitrification, your hogs are keeping it compact, so you haven't nearly the danger of loss that you have under other conditions, although there will be some loss in connection with it. We can't handle manure in any way without meeting some loss, and every man has got to work the matter out to fit his own individual situation. Very likely you are so situated that that particular thing you have been doing has been the best thing to do. It is very possible, if you are hiring men by the year and own the teams, that you can better afford to do that, even at the loss of some of the nitrogen. That is a question of dollars and cents, and it is for each man to make his own decision. All the chemist and the bacteriologist can tell you are the changes that take place, and then you must decide for yourself what you will do in your own particular case.

Question. If it freezes up there is no loss?

Dr. Woods. The loss would be greatly reduced from what it would be if we had an open winter. When I began experiment station work, twenty-five years ago, I thought I understood this theory of chemical handling of fertilizers and crops. It figured right out, and I had no hesitancy in answering questions. If a man sent me the ration that he was feeding, I would tell him whether it was a good or bad one, and how to correct it. In some things you can do that; but each man has got to find out from his own experience. It is probably true that we do not know as much now as we knew positively twenty-five years ago. But don't forget, gentlemen, that we are making enormous advances, because it is a great deal better not to know

things that are so, than it is to know things that are not so.

Question. Would you advise the farmers of Massachusetts to sow alfalfa?

Dr. Woods. Why, if a man likes to play with a thing, yes; but don't sow alfalfa to the extent that you are going to depend on it for bread and butter, or for milk, for the first year. About fourteen years ago, in Connecticut, when I was with a station there, we tried alfalfa as thoroughly as we knew how. We imported soil containing root nodules, or containing the bacteria that form root nodules, and we couldn't make the alfalfa survive our winters. I suppose you will find along Long Island Sound now and then an alfalfa plant that has stayed all these dozen or fifteen years. As there has been a great interest in alfalfa aroused in New England, three years ago we began experiments with it in Maine. I didn't know but it would grow in that beautiful region that we call the "Garden of Maine," the north-east corner of it. It is an elegant piece of land; all it needs is climate. The snow comes before the frost, ordinarily, and so, singularly enough, in that very northern altitude we have almost no frost in the ground. It is naturally underdrained by a broken ledge, so the moment the snow goes in the spring it is ready to work. I didn't know but alfalfa might persist through the winters, under those conditions. In Colorado, when they want to get rid of an alfalfa field, — it is very tough stuff to plow, the roots being bigger than your finger and hard to break, — they flood it with water and leave it for about twenty-four or forty-eight hours, and if by any possibility they can get a little freeze, it is sure to kill the alfalfa. You know we get those conditions in central and southern New England, and so we attributed the loss of our alfalfa in Connecticut to that. We are trying it in Maine, but haven't met with a great deal of success yet. It is hard stuff to get to grow. You have to learn the culture of it. It is not as simple as the ordinary crops we grow. I sent out a lot of seed this year, and about 20 per cent of farmers succeeded in getting a stand. I suppose next year about 5 per cent of those will have

something to go into next winter with. And still, alfalfa on a dairy farm, if it can be established, would be a very good thing; and a man who can afford to do it, and doesn't fool with more than a quarter or a half acre may, during the next ten or fifteen years, master it, and if he does, it will be a very valuable thing. Not to grow it in 1905 and 1906, but to grow it right along to 1910 or 1915 is the aim.

Hon. Wm. R. Sessions (of Springfield). A few days ago I heard of a gentleman within ten miles of our Agricultural College who said he had had alfalfa on his place for years, and had plowed it and couldn't get it out; that the statement that it couldn't be grown was ridiculous, for he couldn't get rid of it.

Dr. Woods. At our college we are told very much the same story you tell us. I wish some expert would examine into the condition of this gentleman who says he can't get rid of it. The last time I had the pleasure of speaking before this Board I heard a man down in Newburyport, I think, — it was down that way somewhere, — say that he had grown alfalfa, and found it an enormous success. He was a dairy farmer, and it was a thing beyond all compare. I wrote him, and didn't get anything very satisfactory, so I went to see him. He wasn't growing any alfalfa then. He told me he had grown it, and it had been a great success.

Mr. Pratt. What kind of soil would you recommend to try it on?

Dr. Woods. Naturally well drained to a good depth. Alfalfa won't get along with wet feet any better than I will. For instance, talking with a man — I think it was yesterday — about the matter, he said he started some and it grew right off, very fine the first season, but the latter part of the season it died. Then he saw he had placed it on land that was underlaid with hard-pan, and when the roots struck the hard-pan they died. It was all right before it got to the depth where there wasn't any drainage; then out it went. Place it preferably, I should say, on a hillside, so the water won't stand on the surface, and not a shallow soil; the subsoil must be 10 or 12 feet deep.

Mr. Pratt. And what time in the year would you sow it?

Dr. Woods. Spring, in this climate, without any doubt. I say it unhesitatingly, because we tried it both in Connecticut and Maine. I say as early as the land can be broken and put in proper shape. You should have begun last spring, and fallowed it and kept it free from weeds all summer. You will have to get rid of your weeds when you grow alfalfa. When it gets up about 6 inches high, if there are many weeds in it, get out your mowing machine. It stands a large amount of trimming like that, so you had a great deal better keep it mown fairly close in order to keep the weeds out of it.

The Chair. This matter of growing alfalfa has been discussed a good deal during the last few years, and I believe that all the time we spend here discussing it now is simply wasted. I don't believe we will ever make a success of it here in New England.

Dr. Woods. May I see the hands of the men who tried soil inoculation for legumes last year? What do you think was your success?

Mr. C. B. Buckley (of Northborough). I tried a crop of Canfield beans. I see no success at all attending the operation. In fact, the piece that I sowed inoculated beans on was not in as good condition as a piece adjoining on which I had an excellent crop of uninoculated peas, for the reason, I concluded, that I had made a mistake in preparing it, or some other such reason. I also received from Professor Brooks of the Agricultural College a quantity of inoculated soil, upon which I grew a field of 3½ acres of soy beans, and there I had an excellent crop.

Mr. Sessions. A friend of mine the other day made this statement. In his garden of peas he applied this bacteria according to directions. He had quite a garden of peas and they did exceedingly well, the vines remaining green all through the season, when on an experimental area near by they turned yellow as soon as the first peas got ripe, and all his neighbors' vines turned yellow. His remained green and were luxuriant through the season, so that he got the benefit of the last of the setting of the peas, and it was an excellent success, he considered. He is a reliable man.

Dr. Woods. That might very likely have been exactly as the man thought it was. Still, men not in the habit of making experiments make mistakes. The president of our university has his own private farm, and he told me that hay he got from 20 pounds of inoculated clover was vastly superior to what he got from 20 pounds of uninoculated. I went there and found the clover on the inoculated side was about twice as tall as that on the uninoculated. But I went two rods farther over on that piece, and the clover wasn't any better than it was there. There happened to be something running right through that patch of clover, and a man not used to experimenting would think simply of one thing. It wasn't so on the whole field, it was simply some accident of soil that caused that.

I haven't any doubt that the inoculating of soil for legumes, where we haven't grown that particular kind of crop, is going to be of very great practical importance. I am only sorry that the cotton culture method hasn't as yet solved the problem, because in such a large percentage of cases their culture didn't carry the right organisms. But I think we are on the right line, and are going to have great success in the near future.

Mr. G. S. Coe (of Natick). I bought some pea culture last spring that came from Pennsylvania, and I soaked some peas in it as directed, and also soaked some cow peas. I had used the cow peas the year before as an experiment, and didn't get any vines big enough to raise pods on them. This year I used the culture on the cow peas and the garden peas both, and planted them near together, and I must say that I believe that the vines from the culture-soaked peas were more than three times as heavy as those where the peas were not soaked; and the cow peas were big enough and grew rank enough, so that I got dry seed, which I have saved. On the same land last year I couldn't get a pod. I don't know as the culture had anything at all to do with it, but for some reason or other I must say I had a splendid crop.

Dr. Woods. Did you look at the roots to see if they had any root nodules on them or not?

Mr. Coe. I did not.

Dr. Woods. Don't misunderstand me to say that all the cultures sent out last year were failures, because they were not; but they were not reliable, so many of them were failures, — perhaps two good ones in eighteen bad ones. It may have been perfectly possible, of course, that those were all right.

The Chair. Do you think the bacteria sent out did any harm? Does its age make any difference?

Dr. Woods. No; all it is necessary to do is to wet the seed in so much water and then dry it right out, and if the seed was thoroughly dried, it would keep indefinitely. If used right off, it would help germination slightly.

The Chair. Didn't it do better in the south than in the north?

Dr. Woods. Naturally so, because most of our soil is already stocked with the right bacteria for the kind of crops we grow up here; and they sent down to the sandy soil and inoculated on that particular soil, and got better results than in the north. I doubt if 99 men out of 100 here would ever be any better off in New England if they had all the cultures they wanted given to them free for the use of clover, because more than 99 per cent of our land is already stocked with the organism; but where we haven't it, it wants to be brought in, of course.

Mr. Coe. Then why is it we can't get clover every year?

Dr. Woods. The use of any mineral fertilizer will have a tendency to bring in and stimulate the growth of clover. The Department of Agriculture investigation showed beyond question that in order to get the best effects from nitrogen-gathering plants it is necessary to grow them on soils that are deficient in available nitrogen. When you apply the mineral fertilizers, that tends to help. On such land as you have been talking about you will probably be helped with some alkali, — such as wood ashes or lime.

The Chair. The reason I asked that question is, last spring we sold several hundred lots of that bacteria, and we advised it simply as an experiment. Some time ago we sent

out something like 100 letters, asking for reports on it, and we have quite a collection. Out of, I should judge, 50 reports that we received, I think there are not over 8 or 10 that are favorable. A large majority of them could see no benefit whatever, and some of them wrote across the bottom, "Nothing but a humbug." Others thought the crop was not as good, and they laid it to the action of this bacteria. That is why I wanted to ask this question, — whether there was any harm in it, — for my own satisfaction. I could see none myself, but a very large majority of the reports was to the effect that it was of no great benefit. I think one of the great causes of this whole thing last year was the exorbitant and outrageous statements made in newspapers and magazines in regard to what might be expected of it. It was simply unreasonable, and I don't know as we should ever have believed it. The attempt to force the crops ahead last spring — potatoes and corn, and every other known crop — with that bacteria simply convinced us that people got an idea from reading these articles in the newspapers and magazines that for 50 cents or $1 they could get a crop of potatoes or corn, or anything. The statements were misleading, and I think the doctor has explained the matter so we will know much more about it.

Question. Did you keep the culture on hand, or send for it?

The Chair. Sent for it in nearly every case. We did not carry it in stock.

Mr. H. M. Howard (of West Newton). Mr. Chairman, ladies and gentlemen, I was very much pleased with the lecture this morning. This question of inoculating the soil is one which I have very carefully studied. Nitrogen is very essential to the production of very early crops; but the speaker told us that nitrification begins slightly in the spring, and as the heat increases above 37° he says the nitrification increases, and therefore he recommends the application of nitrate of soda in small quantities early in the season. He recommended the compact method of manure piling, and if we would take particular notice at that point and keep our manure piles compact during the winter and overhaul

them twice in the spring, the nitrification begins in that manure pile long before it does out doors in the field, and develops the nitrates so that when we apply it to our early crops the nitrates are immediately available and the crops the finest. Another point which the speaker made, and which I thought was very fine, is the intensive cultivation which he recommended. It lets the air into the soil, and oxygen is essential to nitrification. Is that correct?

Dr. WOODS. Yes, sir; that is correct.

Mr. HOWARD. I think those are very fine points, that we should let the air into the soil to sweeten it; and don't be led astray with the idea you are losing nitrogen by putting bedding under your animals and getting it into your manure. You are letting the air into the soil by the use of this horse manure, and you are doing more good than you can ever lose through the loss of nitrogen. You are really helping the soil to develop its nitrogen, and putting it where it will be of benefit to you. In using fall manure I would say that I think there is very little loss from fall manuring where it can be plowed in. But where the crops raised are those which you want early in the season, it would pay the farmer far better to pile his manure and overhaul it in the spring and apply it then, because the nitrates are there ready for the crop.

QUESTION. We have a piece of low ground which is largely composed of vegetable matter. When we plow it, it turns over dark colored. What kind of manure or fertilizer can I put on that to the best advantage? I can guess that ashes might be good; I can guess that stable manure might be good; I can guess that hen manure might be good. I have those fertilizers. Which of those three fertilizers that I have mentioned would be best for me to use?

Dr. WOODS. It is hard for me to answer that, without knowing a little more about the low ground than I do; but the chances are, if it hasn't been thoroughly well drained, it will be a little acid, and consequently ashes and lime would help that. If deficient in nitrogen-transforming organisms, stable manure would probably give returns far beyond any manurial value that is in the manure itself because of the

bacteria. If deficient in minerals, you would have to add some phosphoric acid and potash to it.

Mr. Howard. What is the value of the nitrogen which is in the clover crop as grown?

Dr. Woods. You mean as a fertilizer, if it were plowed under green? Organic nitrogen in that form is quite readily available for plants. If it goes under ground, there are usually ferments enough that commence and break it down very speedily. I shouldn't hesitate to say, of green clover plowed in, that the nitrogen would be worth as much as that of cotton-seed meal, for instance.

Mr. Henry A. Turner (of Norwell). Suppose it isn't plowed in, but allowed to remain on the surface; do you get the benefit of the nitrogen?

Dr. Woods. Never plowed in?

Mr. Turner. Not to plow it in at all.

Dr. Woods. Why, you will get the benefit from that which is accumulated in the roots, but you will get but very little benefit from the tops.

Mr. Sessions. The Board of Agriculture and other friends who have met here and enjoyed these meetings are under extreme obligations to the two organizations which have invited us here, the Worcester County Horticultural Society and the Worcester Agricultural Society. There are very few organizations that can offer such beautiful accommodations as has the horticultural society to us here. This hall is one of the very best in the city for meetings of this kind. But I want to emphasize also the fact that the location of this meeting is in the midst of a community that takes an interest in such meetings, as is proved by the attendance we have had here through these three days. But I arose to move a hearty vote of thanks to the two societies as hosts of this Board and its friends in the invitations which have been extended to us.

Mr. Pratt. I wish to second the motion by saying that I believe we understand that everything has been done by the citizens and the societies to make our stay here pleasant.

Unanimous vote.

Mr. C. W. Wood (of Shrewsbury). Mr. Chairman, ladies and gentlemen: Those of you who know the gentlemen upon the platform connected with the Board are well aware that they never do any talking when they can get some other fellow to do it for them; and so I have been asked to extend to you an invitation, or, in other words, after a conference with the secretary of the Board, I requested him to extend it to you, and he is now asking me to come in and expatiate upon that invitation. I don't know that I need to do this. Therefore I will simply say that Mrs. Wood joins me in extending to every lady and gentleman here and their friends an invitation to visit Crescent Farm this afternoon. And lest you may be induced to go down there under a misrepresentation or delusion, I desire to say to you that you will find there not an exhibition of elegance and expenditure such as the ordinary farmer cannot indulge in. You are well aware that many gentlemen engaged in other vocations in life, who earn a great deal of money in the cities, frequently find it convenient to go into the country to spend it. Now, it is delightful to visit such places; it is delightful to see the elegance attendant, and the care and treatment of the animals; it is very pleasant to see work done in that manner; but we, all of us who are farmers, go home saying to ourselves, "That is not practical: we can't do that, and we know very well that it doesn't pay." Now, you are not invited this afternoon to visit such a place. You are invited to visit a place where we think you will be given an example of practical and fundamental principles. The three important factors that influence us in the conduct of the farm are absolute cleanliness, regularity and kindness. That, with intelligence, to our mind makes the ideal country home, or, in other words, just such a home as every farmer ought to have. You will find nothing there beyond the reach of the ordinary farmer who obtains his living from the soil he cultivates. It has been our aim and object, if possible, to exhibit to those surrounding us an object lesson of what the farmer should do. We hope we shall be able this afternoon to convince you that we have to some little degree attained

our ambition in that direction. You will do us great kindness, and it will be a great pleasure to us, if every one of you will go down this afternoon. The cars leave in front of this hall at twenty-five minutes past 1. You will be twenty-one minutes going down, reaching the farm at 2 o'clock, where you will be asked to view both the inside of the barn and the inside of the house. We hope that it may give you some new inspiration, and perhaps lead your mind to some new ambitions.

Those who live in Boston can, if they prefer, continue on the electric car for thirty-five minutes into Boston, getting into Boston as quickly as if they returned to Worcester and took the steam cars. It is possible to go down and back in two hours; but we hope, however, that you will see enough to occupy your attention so that you will favor us with just a little longer visit.

Adjourned *sine die* at 12.10 P.M.

A large number of those present at the forenoon session availed themselves of the opportunity to visit Crescent Farm in Shrewsbury, and left there with feelings of gladness that they had been led to accept Mr. and Mrs. Wood's kind invitation. The weather was mild, and the conditions for the excursion were delightful. The inspection of the farm proved a source of pleasure, and the attentions of the host and hostess were greatly enjoyed.

ANNUAL MEETING

OF THE

BOARD OF AGRICULTURE

AT

BOSTON.

JANUARY 9 AND 10, 1906.

ANNUAL MEETING.

In accordance with the provisions of chapter IV. of the by-laws, the Board met at the office of the secretary, in Boston, on Tuesday, Jan. 9, 1906, at 11 o'clock A.M., it being the Tuesday preceding the second Wednesday of January. The Board was called to order by Second Vice-President AUGUSTUS PRATT.

Present: Messrs. Akerman, Allen, Anderson, Appleton, Bradway, Bursley, Burt, Damon, Danforth, Albert Ellsworth, J. L. Ellsworth, Jewett, Kilbourn, Leach, Mason, Nye, Paige, Pease, Peters, Porter, Pratt, Reed, Richardson, Ross, Shaylor, Spooner, Turner, Williams and Worth.

Records of special business meetings of the year, also records of the executive committee, read and approved.

The executive committee, as committee on credentials, by Mr. Kilbourn, chairman, reported the list of qualified members of the Board for 1906. The newly constituted members are as follows: —

At large, appointed by the Governor, Gen. Francis H. Appleton of Peabody.

Elected from the —

Amesbury and Salisbury Society, J. J. Mason of Amesbury.

Hampshire, Franklin and Hampden, William A. Bailey of Northampton.

Blackstone Valley, Samuel B. Taft of Uxbridge.

Hingham, Edmund Hersey of Hingham.

Housatonic, Edwin L. Boardman of Sheffield.

Marshfield, H. A. Oakman of Marshfield.

Massachusetts Horticultural, William H. Spooner of Jamaica Plain.

Hoosac Valley, A. M. Stevens of Williamstown.

Massachusetts Society for Promoting Agriculture, N. I. Bowditch of Framingham.

Nantucket, H. G. Worth of Nantucket.
Weymouth, Q. L. Reed of South Weymouth.
Worcester East, W. A. Kilbourn of South Lancaster.

The committee reported that a protest had been filed against the acceptance of the credential of the delegate elected by the Eastern Hampden Agricultural Society, which credential and protest were by vote referred to the executive committee.

Voted, That the rest of the report of the committee on credentials be accepted and adopted.

The secretary read his annual report, which was accepted by unanimous vote.

On motion of Mr. Jewett, it was

Voted, That a committee of five be appointed by the Chair to consider and act upon that part of the secretary's report which refers to the codification and revision of the agricultural laws.

Later in the day the Chair appointed Messrs. Jewett, Spooner, Ross, Kilbourn and Bursley as the committee, which appointments were confirmed by vote of the Board. Also, by vote, the secretary was added to the committee.

The report of the Dairy Bureau was read by the general agent, Mr. Harwood, and was accepted and adopted.

At 12.30 o'clock the Board adjourned to 2 P.M.

The Board was called to order by Mr. PRATT at 2.10 P.M.

Mr. Kilbourn, for the executive committee, reported that a hearing on the matter of the Eastern Hampden Agricultural Society would be held at 3 o'clock.

The committee on Massachusetts Agricultural College, by Mr. Bursley, chairman, presented a written report, which was accepted and adopted as the report of the Board of Overseers to the Legislature.

The committee on experiments and station work, by Mr. Spooner, chairman, presented a written report, which was accepted and adopted.

General Appleton, for the committee on forestry, roads and roadside improvements, reported that no written report had been prepared, giving reasons therefor, and asked leave to report at a later date to the executive committee, which request was granted by vote of the Board.

The committee on institutes and public meetings, by Mr. Hersey, chairman, presented a written report, which was accepted and adopted.

The eighth semiannual report of the chief of the Cattle Bureau was presented by Dr. Peters, who read a portion of the same, and the report was accepted.

The State Forester, Mr. Akerman, presented a verbal extract of his report to the Legislature.

At 3 o'clock a hearing was held on the question of the acceptance of the credential of Mr. O. E. Bradway, he claiming to be the accredited delegate from the Eastern Hampden Agricultural Society. This claim was disputed by Mr. A. C. Stoddard, who stated that he had been chosen as the delegate at the regular annual meeting of said society. The matter was heard somewhat at length, when, on motion of Mr. Worth, it was

Voted, To refer the whole subject to the executive committee, with power to act.

An abstract of the reports of inspectors of fairs, prepared by direction of the committee on agricultural societies, was read and accepted.

At 4.40 o'clock the Board adjourned to 9.30 A.M. Wednesday.

SECOND DAY.

The Board was called to order by Second Vice-President PRATT, at 9.40 A.M.

Present: Messrs. Akerman, Allen, Anderson, Appleton, Bailey, Boardman, Bradway, Bursley, Damon, Danforth, Albert Ellsworth, J. L. Ellsworth, Guild, Jewett, Kilbourn, Leach, Mason, Nye, Oakman, Paige, Pease, Peters, Porter, Pratt, Reed, Richardson, Ross, Spooner, Stevens, Williams and Worth.

The records of the first day were read and approved.

The fourth annual report of the State Nursery Inspector was presented, accepted and adopted.

The committee on agricultural societies, by Mr. Kilbourn, chairman, presented a written report, which was accepted and adopted.

Election of officers being in order, the chairman declared His Excellency Curtis Guild, Jr., president of the Board (by a by-law of the Board the Governor is *ex officio* president).

Further elections by ballot resulted as follows: —

First Vice-President, Hon. WILLIAM R. SESSIONS of Springfield.

Second Vice-President, Mr. AUGUSTUS PRATT of North Middleborough.

Secretary, Mr. J. LEWIS ELLSWORTH of Worcester.

General Agent of the Dairy Bureau, Mr. PETER M. HARWOOD of Barre.

State Nursery Inspector, Dr. HENRY T. FERNALD of Amherst.

Election of specialists being in order, ballots were taken, and the elections resulted as follows: —

Chemist, Dr. C. A. GOESSMANN of Amherst.[1]

Entomologist, Prof. C. H. FERNALD of Amherst.[1]

Botanist, Dr. GEO. E. STONE of Amherst.[1]

---

[1] Massachusetts Agricultural College.

Pomologist, Prof. F. A. WAUGH of Amherst.[1]
Veterinarian, Prof. JAMES B. PAIGE of Amherst.[1]
Engineer, WILLIAM WHEELER of Concord.
Ornithologist, EDWARD HOWE FORBUSH of Wareham.

The secretary appointed his first clerk, Mr. F. H. Fowler, librarian for the ensuing year.

The Chair announced the standing committees as follows (the secretary is, by rule of the Board, a member *ex officio* of each of the standing committees): —

Executive committee: Messrs. W. A. Kilbourn of South Lancaster, John Bursley of West Barnstable, William H. Spooner of Boston, Francis H. Appleton of Peabody, Augustus Pratt of North Middleborough, C. D. Richardson of West Brookfield, Edmund Hersey of Hingham, Henry S. Perham of Chelmsford.

Committee on agricultural societies: Messrs. W. A. Kilbourn of South Lancaster, Q. L. Reed of South Weymouth, O. E. Bradway of Monson, J. Harding Allen of Barre, Albert Ellsworth of Athol.

Committee on domestic animals and sanitation: Messrs. Henry S. Perham of Chelmsford, Johnson Whiting of West Tisbury, John S. Anderson of Shelburne, Henry E. Paige of Amherst, A. M. Stevens of Williamstown.

Committee on gypsy moth, insects and birds: Messrs. Augustus Pratt of North Middleborough, J. M. Danforth of Lynnfield, W. C. Jewett of Worcester, H. H. Leach of North Brookfield, Walter D. Ross of Worcester.

Committee on Massachusetts Agricultural College: Messrs. John Bursley of West Barnstable, W. C. Jewett of Worcester, Isaac Damon of Wayland, A. H. Nye of Blandford, E. L. Boardman of Sheffield.

Committee on experiments and station work: Messrs. Wm. H. Spooner of Boston, N. I. Bowditch of Framingham, Ralph M. Porter of Cummington, E. P. Williams of Ashfield, H. A. Oakman of Marshfield.

Committee on Dairy Bureau and agricultural products: Messrs. C. D. Richardson of West Brookfield, J. M. Danforth of Lynnfield, Henry E. Paige of Amherst, W. M. Wellington of Oxford, S. B. Taft of Uxbridge.

---

[1] Massachusetts Agricultural College.

Committee on forestry, roads and roadside improvements: Messrs. Francis H. Appleton of Peabody, H. G. Worth of Nantucket, J. J. Mason of Amesbury, Henry S. Pease of Middlefield, W. M. Wellington of Oxford.

Committee on institutes and public meetings: Messrs. Edmund Hersey of Hingham, H. S. Perham of Chelmsford, Wm. R. Sessions of Springfield, Wm. A. Bailey of Northampton, Kenyon L. Butterfield of Amherst.

These appointments were approved by vote of the Board.

On invitation, Mr. C. F. Pidgin, chief of the Bureau of Statistics of Labor, briefly addressed the Board on matters concerning the agricultural census of the Commonwealth to be taken the present year.

The ornithologist to the Board, Mr. Forbush, made brief remarks concerning his labors as ornithologist, referring particularly to the special report on birds authorized by the last Legislature, and now in the hands of the printers.

Voted, That the secretary be authorized to reprint the schedule of duties of inspectors for the use of members of the Board.

The secretary stated that invitations had been received for the holding of the next public winter meeting of the Board, when it was

Voted, That a special committee of five be appointed by the Chair to consider these invitations, with power to report a place for holding the next public winter meeting.

The Chair appointed Messrs. Danforth, Kilbourn, Bailey, Bursley and Secretary Ellsworth as this committee.

His Excellency Governor Guild, coming in, was presented to the Board and took the chair.

Mr. A. H. Kirkland, State Superintendent for suppressing Gypsy and Brown-tail Moths, on invitation, addressed the Board on the present condition of the infested territory and of the work against the pests now being carried on. On motion of General Appleton, it was unanimously

Voted, That, in the opinion of this Board, and in order to secure the necessary inter-State action to suppress the dangers from the gypsy and brown-tail moths, the aid of the national government is a positive necessity.

And that the secretary of this Board be directed to send a copy of the foregoing vote to the Secretary of Agriculture and the Massachusetts Senators and Representatives in Congress.

Voted, That the legislative committee be instructed to consider the work of the ornithologist to the Board in the interests of protecting and preserving the beneficial birds of the Commonwealth, with power to apply to the Legislature, if deemed wise, for funds with which to continue such work and to pay for services that may be performed.

The special committee on the public winter meeting reported in favor of holding the next public winter meeting in Springfield, when it was

Voted, to accept the report of the committee, and to hold the next public winter meeting in Springfield.

A special assignment, the request of the Middlesex North Agricultural Society for the approval by the Board of Agriculture of its vote, passed at a meeting of the society held on Dec. 8, 1905, that "it is the sense of the Middlesex North Agricultural Society that it be hereby authorized to sell the whole or any portion of its real estate, and convey the same by such deeds or other instruments as may be necessary to transfer the legal title thereto," was considered.

The president of the society was present, and stated the reasons for the sale. It appearing that the meeting at which the vote was passed was legally called and held, that the vote was by the necessary two-thirds, that the request for approval had been properly advertised, and no person appearing in opposition to the request, it was

Voted, To approve the said vote of the said Middlesex North Agricultural Society, in accordance with the provisions of section 6 of chapter 124 of the Revised Laws.

Voted, To hold a summer meeting of the Board, and that the arrangements for same be left with the committee on institutes and public meetings.

Voted, That Messrs. Nye, Paige and Boardman be added to the committee on institutes and public meetings, to assist in arranging for the next public winter meeting.

Mr. Kilbourn, for the committee on agricultural societies, reported the assignment of inspectors, as follows: —

Amesbury and Salisbury, at Amesbury, September 25, 26 and 27,	W. C. Jewett.
Barnstable County, at Barnstable, August 28, 29 and 30,	H. S. Pease.
Blackstone Valley, at Uxbridge, September 21 and 22,	Johnson Whiting.
Deerfield Valley, at Charlemont, September 13 and 14,	H. E. Paige.
Eastern Hampden, at Palmer, October 5 and 6,	H. S. Perham.
Essex, at Peabody, September 18, 19 and 20,	J. H. Allen.
Franklin County, at Greenfield, September 19 and 20,	W. D. Ross.
Hampshire, at Amherst, September 18,	N. I. Bowditch.
Hampshire, Franklin and Hampden, at Northampton, October 3 and 4,	Albert Ellsworth.
Highland, at Middlefield, September 5 and 6,	A. Pratt.
Hillside, at Cummington, September 25 and 26,	W. A. Kilbourn.
Hingham, at Hingham, September 25 and 26,	W. H. Spooner.
Hoosac Valley, at North Adams, September 21 and 22,	H. H. Leach.
Housatonic, at Great Barrington, September 25, 26, 27 and 28,	H. G. Worth.
Marshfield, at Marshfield, August 22, 23 and 24,	W. M. Wellington.
Martha's Vineyard, at West Tisbury, September 18 and 19,	R. M. Porter.
Massachusetts Horticultural, at Boston, September 5 and 6 and October 10 and 11,	F. H. Appleton.
Middlesex North, at Lowell, September 13, 14 and 15,	Q. L. Reed.
Middlesex South, at Framingham, September 18 and 19,	C. D. Richardson.
Nantucket, at Nantucket, August 22 and 23,	A. H. Nye.
Oxford, at Oxford, September 6 and 7,	J. J. Mason.

Plymouth County, at Bridgewater, September 12 and 13, ...	A. M. Stevens.
Spencer, at Spencer, September 20 and 21, .	E. L. Boardman.
Union, at Blandford, September 12 and 13, .	John Bursley.
Weymouth, at South Weymouth, August 31 and September 1 and 2, ...	E. P. Williams.
Worcester, at Worcester, September 3, 4, 5 and 6, ...	J. M. Danforth.
Worcester East, at Clinton, September 12, 13 and 14, ...	John A. Anderson.
Worcester Northwest, at Athol, September 3 and 4, ...	Isaac Damon.
Worcester South, at Sturbridge, September 13 and 14, ...	Wm. A. Bailey.
Worcester County West, at Barre, September 27 and 28, ...	H. A. Oakman.

The report of the committee was accepted and adopted.

Voted, That any unfinished business or new business that may arise be referred to the executive committee, with power to act.

The records of the second day were read and approved.

The meeting was then dissolved.

J. LEWIS ELLSWORTH,
Secretary.

REPORT OF COMMITTEE ON AGRICULTURAL SOCIETIES.

[Read and accepted at the Annual Meeting, Jan. 10, 1906.]

The committee on agricultural societies report that they have considered the reports of inspectors of fairs, and they find no mention of any objectionable features, or a statement that, if any such appeared, they were promptly removed. We would urge upon the inspectors careful attention, to the end that our fairs may be protected from giving just cause for criticism in the kind of amusements or entertainments allowed.

We fully agree with the report of the secretary of the Board in his recommendation that all attractions outside those strictly instructive should be discouraged.

Respectfully,

W. A. KILBOURN.
J. HARDING ALLEN.
O. E. BRADWAY.

REPORT OF COMMITTEE ON EXPERIMENTS AND STATION WORK.

[Read and accepted at the Annual Meeting, Jan. 9, 1906.]

The State Board of Agriculture may be considered a kind of board of trade for the farmer, and the experiment station a clearing house for correcting errors in theory or practice.

Farming in Massachusetts is of necessity confined chiefly to the dairy, poultry, the orchard, and the market garden in its broadest application, including plants and flowers. It must therefore be a benefit to visit the station, where the busy professors are doing important work for the farmer, showing him by their scientific investigations what to avoid and what to adopt, without the expense of personal tests. With the demands made upon the farmer in the production of pure milk, by the requirements of the State Board of Health and city boards, exacting improved stables, clean milk cans, clean clothing, clean hands properly manicured, the *consumer* should in return demand justice for the *farmer*, in that he should be entitled to a higher price for all this extraordinary care, instead of giving the benefit to the *middle* man.

The entomological department is in excellent condition, with greatly improved facilities, more room having been added for students and more for experimental work under glass.

The botanical department is doing valuable work in its experiments in greenhouse cultures; with the increasing amount of market gardening many products are grown under glass, such as tomatoes, cucumbers, lettuce, etc.

In the horticultural department the professor has devised an excellent system of judging fruits by points, which has,

we think, been adopted by the American Pomological Society. He has also plans for the improvement of the package for shipping fruit for the best markets; but it is essential first to produce fruit *worthy* to be shown in the improved package; this needed improvement is a subject well worthy the attention of this Board.

In the agricultural department, the "questions affecting the selection and use of manures and fertilizers" occupy much attention, and the final results will be watched with interest.

It has been said that the work of the station has been directed to the *scientific* rather than to the *practical* side of farming, and this may, in a measure, be true; but by summing up the work of these various departments we realize the great value of the experiment station. If any department should be engaged in special investigation, would it not be well for the professor in charge to present a report to the Board of Agriculture at its annual winter meeting, so that all interested may receive the benefit and have an opportunity of asking questions?

Respectfully submitted,

WM. H. SPOONER,
Chairman.

REPORT OF COMMITTEE ON INSTITUTES AND PUBLIC MEETINGS.

[Read and accepted at the Annual Meeting, Jan. 9, 1906.]

The institute meetings are every year becoming more interesting and instructive. As new and improved methods of feeding animals and plants are discovered, a broader field for lecturers to work is opened, making their work not only more interesting, but of greater value.

Employing competent persons to lecture in different parts of the State gives the farmers an opportunity to listen to new and improved methods of conducting the farm, — methods which decrease the cost of producing the crops, and at the same time increase their value.

The summer meeting of the Board was held at Lowell, and was well attended by the members and people living in that section of the State.

The winter meeting was held at Worcester; it was well attended by members of the Board and others. The lectures were both interesting and instructive. They stated many facts which should enable the farmers to get a better understanding of how to produce crops of a better quality at a smaller cost, consequently bringing them a much greater profit.

Respectfully submitted,

EDMUND HERSEY,
Chairman.

Report to the Legislature of the State Board of Agriculture, acting as Overseers of the Massachusetts Agricultural College.

[Revised Laws, chapter 89, section 10, adopted by the Board, Jan. 9, 1906.]

To the State Board of Agriculture, Overseers of the Massachusetts Agricultural College.

At the beginning of the present college year the number of students, 210, the greatest number ever enrolled for the regular course, proves that there is an increased interest of our people in our excellent Agricultural College.

There has also been a steady gain of those who take the short or winter course, many of those being not *boys* but *men*, who feel that the present age demands that they fit themselves especially in the line of work they would pursue.

At commencement in June the Grinnell prizes were awarded to Bertram Tupper of Barre and to Harold Foss Thompson of Jamaica Plain.

The college has suffered a great loss in the death of its loved and honored president, Dr. H. H. Goodell. The taking of one who as instructor and president had spent nearly all of his life in work for the institution makes a gap not easily filled. We commend the action of the trustees in their careful deliberation before electing his successor.

At our October visit we found the farm had yielded returns fully up to the average. We suggest it might be well to plant some portion to flint corn, and not depend upon a dent variety for the entire crop.

The dairy herd was the best we have ever seen at the farm, and one that any similar institution might well be proud of. We greatly regret that the loss of the barn by

fire so shortly after necessitated the sale of the greater portion of this herd.

Wilder Hall, the new brick building for use of the horticultural department, is now nearly completed. This will relieve the congested condition of the class room in the Botanic Museum, also furnish more suitable accommodations for those now obliged to use a portion of the vegetable house.

That the present Legislature will grant at an early date an ample appropriation for a new barn, ice house and dairy room, to replace those destroyed by the November fire, is the earnest hope of all those interested in the college as well as those connected with it.

The botanical department is greatly in need of new buildings both for its class room and laboratory work, and for a glass house, where the students may get an insight into commercial vegetable growing under glass.

We believe the increasing number of students indicates that our citizens are becoming more fully awake to the opportunities offered for obtaining a good education at this institution. Therefore, let the Commonwealth provide for the needed buildings and the equipment of the same; when, under the wise direction of the newly elected president, Kenyon L. Butterfield, we predict a brilliant future for the college.

Respectfully submitted,

JOHN BURSLEY.
ISAAC DAMON.
CHAS. H. SHAYLOR.
A. H. NYE.

REPORT OF COMMITTEE ON GYPSY MOTH, INSECTS AND BIRDS.

[Read and adopted at the Public Winter Meeting, Dec. 5, 1905.]

To the Massachusetts State Board of Agriculture.

In making its report, your committee on gypsy moth, insects and birds would call attention to its recommendations of a year ago, and to their practical acceptance by the Legislature of 1905. At that time we recommended that the work be placed in the hands of a paid commission, with a large appropriation, to be extended over a number of years with a maximum and minimum amount to be expended in any one year, and the work to be carried on against the insect at all seasons and in all forms.

The last General Court enacted a bill for the appointment of a State superintendent of the gypsy and brown-tail moth work, at a salary to be fixed by the Governor and Council, with an appropriation of $300,000 up to and including May 1, 1907. Of this amount $75,000 could be expended during the present year, $150,000 and any unexpended balance of the previous year during 1906, and $75,000 and any unexpended balance of the previous years during 1907, up to and including May 1. The act also provides for the co-operation of municipalities in the work against these insects, and fixes the amounts which they are required to spend and the reimbursement which they shall receive from the treasury of the Commonwealth.

The only direct recommendation of this committee which did not meet with the approval of the Legislature was that which called for work against the insect at all seasons and in all forms. The act passed at the last session of the Legislature, and under which the State superintendent is now at

work, does not allow of anything being done against either the gypsy or the brown-tail moth in the caterpillar stage, — the most obvious and serious defect of a by no means perfect enactment. It practically limits the work of suppression to eight months of the year, when experience has shown that the entire twelve are none too long if anything of serious import is to be accomplished.

The State superintendent is further hampered by the fact that he has no direct control over the appointment of the board or official to have charge of the work in any municipality, of the hiring of subordinate employees, nor of the time of making appropriations. These facts weaken his authority and work against that centralization of management which is so essential to an undertaking of this magnitude. Your committee would earnestly recommend that the Board use its influence to induce the Legislature of 1906 to amend the law in such a manner as to do away with these obvious and vital defects.

Acting under the provisions of the act above referred to, Governor Douglas, on May 10, 1905, appointed A. H. Kirkland, M.S., the State superintendent of the work against the gypsy and brown-tail moths. Mr. Kirkland was in the employ of this committee at the time it was carrying on the work against these insects, and had been acting director for six months prior to the stopping of the work by the Legislature of 1900. This appointment was made with the full approval and hearty endorsement of your secretary and this committee.

When the work was brought to a close, in 1900, at the end of a fight marked by prejudice and passion on the part of the opponents of the work and of this Board, we felt that patience was all that was needed, and that the vindication of our work, inevitable because of its honesty and efficiency, would come in due season. Five years have gone by, and we see the work resumed along lines marked out by this committee and endorsed by this Board, with one of our most trusted and efficient former lieutenants at its head, surrounded and supported by men trained in the service of this committee, and working along the only lines left for possible

effective work after the long period of cessation of effort against these insects. It is to be regretted that the possibility of extermination no longer exists, and that the only result of future work possible is the prevention of the spread of the gypsy moth and the reduction of the damage it will occasion in the infested territory. Chastened and subdued by the experiences of the past five years, none of the former opponents of the work are now so bold as to claim that the gypsy moth is a humbug, and that with the stoppage of appropriations by the State the damage from the insect would also cease. Those who took part in the campaign for the bringing of the work of this committee to a close are now silent, nor are they at all desirous of being known as active agents in fastening this great annual tax on the Commonwealth and the cities and towns of the infested region for all time.

On June 30, 1905, your committee, together with the executive committee of the State Grange, Superintendent Kirkland and others interested, made a visit of inspection to the infested territory. Enough was seen on that visit to show the constant and increasing menace of the gypsy moth, and to prove that action against it could not have been longer delayed without even more serious and far-reaching consequences. At the park in Arlington we found the trees stripped bare as in winter; great masses of caterpillars gathered on the trunks and festooning from the limbs; the seats covered and in places the ground literally carpeted with the crawling insects, migrating in search of the food destroyed in that particular place by their own voracious appetites, — all this in spite of a very active and intelligent campaign carried on against the gypsy moth by the citizens of the town, probably more work and better concerted effort having been put out here by the citizens than in any other municipality. The park was practically useless for park purposes, in such condition that no one would frequent it unless compelled to do so, and not likely to be of any permanent value as a breathing spot for the public in the future, or at least for some years to come. The same conditions prevailed in many other parts of the territory, as

shown by our visit of inspection. The stripping of trees was much in evidence, particularly in woodland colonies that had been long neglected, and there were numerous dead and dying trees to be seen, in deciduous varieties as well as among the evergreens.

For the facts and figures which follow as to new infestation discovered we are indebted to State Superintendent Kirkland. At the close of the work of this Board in 1900 there were 359 square miles of territory infested by the gypsy moth. The unchecked spread of the insect during 1900, 1901, 1902, 1903, 1904 and the first half of the current year has resulted in the infestation at the present time of 2,083 square miles. To-day the insect is to be found, in Massachusetts, from the New Hampshire line on the north to Cape Cod on the south and Worcester County on the west. One town in the latter county, Southborough, has also been found to be infested during the present year. The infestation south of Boston is light as compared with that on the north of the city, being mainly in scattered colonies of recent establishment, but calls for no less vigorous action on the part of State and local officials.

It would be impossible to state the limits of the infestation by the brown-tail moth with any degree of accuracy. It is known to be in many towns in Worcester County, and is probably even farther west. It has extended well down into Maine, and it is not likely that the extent of its infestation of that State is realized as yet. Its spread to the south and southeast is comparatively slow, and the infestation in those directions light, due in a large measure to the southwest winds usually prevailing during the flight season of the insect. Experience has shown that this insect is much more susceptible of control than is the gypsy moth, and that an energetic campaign during the winter months will always ensure its comparative rarity in any locality the following season. The unpleasant nettling effects produced upon the skin have also a decided tendency towards making individual property holders more anxious to secure its eradication from their premises, and to this extent simplifies the official work of suppression.

The gypsy moth is known to be in New Hampshire and Rhode Island, as well as in Massachusetts; and, from the fact that the infestation extends to the Maine line, there is a strong probability that it will be discovered to be in that State also. With its presence in three States, and possibly in four, the question has ceased to be one for Massachusetts alone, and has developed into what may fairly be said to be a national question. The reluctance of the national government to take up the work is but natural; but when a great national menace to the agricultural interests of the country appears, it is none the less the duty of that government to interfere. The national government does not hesitate to take an active hand in the suppression of foot and mouth disease when it appears among the cattle of any section, and much praiseworthy work has been done by it in stamping out this and other diseases. It may be true that the government has never made a direct appropriation for the destruction of any insect; but a grave crisis confronts us, requiring the creation of new precedents, if necessary. The gypsy moth is slow in its spread; but if left to itself, or limited only by the action of officials bounded by municipal and State lines, it is inevitable that in the course of time it will make its way into all the States and Territories. With such extension of infestation goes the inevitable destruction of our orchards and forests. Animal diseases may run themselves out; the gypsy moth has shown that on this continent its natural control can only be brought about by the establishment of the balance of nature for which centuries are required. It seems to your committee that the time has come for the national government to take up this work, either independently or in conjunction with the State authorities, and no effort will be spared in that direction during the coming winter.

At the annual meeting of the National Association of Farmers' Institute Workers, held at Washington, D. C., Nov. 9–11, 1905, a resolution was introduced by your secretary, at the request of gentlemen from other States, calling on the national government to make appropriation and take an active part in the work against the gypsy moth,

which resolutions were unanimously adopted by the association. Your secretary has since communicated with the executive officers of the agricultural departments of neighboring States, and received their assurances of co-operation in any movement looking to the securing of national aid for the work against the insect.

We would recommend that the Board request the next Legislature to memorialize Congress, and to request that an appropriation be made for this work; and, further, that the Board adopt resolutions requesting the co-operation of the Massachusetts delegation in the National Senate and House of Representatives in the securing of such an appropriation. We would further recommend that your secretary be empowered to proceed to secure the co-operation, so far as possible, of all the various State departments of agriculture and of other societies and institutions interested in the welfare of agriculture, in an effort to secure national aid against this common menace to our agricultural interests.

Respectfully submitted,

AUGUSTUS PRATT.
WALTER D. ROSS.
JOHN M. DANFORTH.
HENRY H. LEACH.
W. C. JEWETT.
J. LEWIS ELLSWORTH.

FOURTH ANNUAL REPORT

OF THE

STATE NURSERY INSPECTOR

OF THE

MASSACHUSETTS BOARD OF AGRICULTURE.

PRESENTED TO THE BOARD AND ACCEPTED,
JAN. 10, 1906.

FOURTH ANNUAL REPORT OF THE STATE NURSERY INSPECTOR.

To the Secretary of the Board of Agriculture.

I have the honor to submit herewith the fourth annual report of the State Nursery Inspector.

The duties of the inspector during 1905 have not been different in any way from those hitherto performed, and the work has been carried on in the usual manner. Every year a few requests for spring inspection have been made and fulfilled, and a few inspections of places where continuous sales occur have been made in July, in order that there might be no time between the expiration of one certificate and the granting of the next; and the present year has been no different from preceding ones in this regard. Most of the work, however, as heretofore, has been done in August and September.

As regards the places visited, several former nurserymen are now out of business, but others have started nurseries, the entire number of places to visit being one hundred and twenty-eight, held by one hundred and twenty owners. Of these, one hundred and eighteen have been inspected and have received certificates; one is so infested that sales are made in accordance with the fumigation requirements of the law; and one is for sale as a whole, the owner having died, and no business is being transacted pending such sale.

The most common pests found on nursery stock in Massachusetts were considered in the last report of the inspector. Since then, however, the investigations of the State Gypsy Moth Commission have shown a much wider distribution of the gypsy and brown-tail moths than was then supposed. Despite this, the gypsy moth is as yet not a greater factor in nursery inspection than before, as its increased territory has not seemed to bring it into any of the nurseries. With

the brown-tail moth it is different. This insect may now be present in one hundred and four places, and has actually been found in more than half of them. When it is present and the inspection is made after the 10th of September it is possible to find and remove this pest, as it has then constructed its winter tents. Earlier than this date no inspection can be made which will be certain to discover all the brown-tail moths, as these insects will then be present either in the egg stage or as tiny caterpillars, and neither can be sure of discovery without examining every leaf on every tree, — manifestly an impossible task. Yet, as shipments of some kinds of stock must be made by the middle of August, the beginning of inspection cannot be delayed beyond that time; and in consequence the inspector, after consultation with the secretary of the Board of Agriculture and with Mr. A. H. Kirkland, the superintendent of the Gypsy Moth Commission, has been forced to rule that certificates granted to Massachusetts nurseries shall not be considered as covering the brown-tail moth.

That this is much to be regretted no one appreciates more than the inspector; but the only alternative would be to make no inspections till about September 10, and to forbid all shipments of stock till after that date. This, however, would necessitate a much larger force of inspectors if the work were to be completed in time, for with the present force it takes six to eight weeks at least to make the rounds of the nurseries, and if the work were begun three or four weeks later, the last nurseries would be reached after the shipping season was practically over. The deputies now accept their appointments because they can obtain about a certain sum for their labor; while, if that sum were to be divided among twice as many, they would not receive enough for the time they would spend to make it pay them to give up whatever employments they might have. From these facts it seems evident that no other action as to the brown-tail moth could have been taken last fall. Whether it would be best to delay inspections so as to include the brown-tail moth, and still finish the work early enough not to interfere with the shipping season, by obtaining changes in the law

which would permit the appointment of more deputies, and a consequent larger appropriation, is a question hardly within the province of the inspector to decide.

The San José scale has been unusually plentiful in the nurseries this year, and in nearly every case this has been due to one of two causes. Much of the infested stock was bought last spring from other States, and bore certificates of inspection. This of itself is a comment on the inspection laws of the States concerned, or possibly on the quality of the inspectors of those States. The other cause of infestation is the presence of the scale on trees or shrubbery in or near the nursery. The inspection law gives the inspector no authority as regards any trees or plants not for sale, and a nursery may be planted in the midst of a badly infested orchard over which he has no control. In one case a nursery is on three sides of a house lot the trees on which are dying from the San José scale, and, in consequence, each year the stock nearest that lot is badly infested. The owners of the nursery are aware of the conditions, and have done everything in their power to induce the owner of the lot to remove the infested trees, but in vain.

It is not one of the duties of the inspector to examine the surroundings of a nursery, but in order to understand local conditions this has been done as far as possible; and thirty places are now known where nurseries are annually exposed to infestation either from trees growing in the nursery itself or near by. So long as this continues we may expect to find infested stock, which must be discovered and removed each year. It is the practice of the inspectors to notify the owner of the nursery of surrounding conditions as they discover them, and this has done much good in some cases; but too often, as has already been stated, there was nothing which could be done to improve the conditions.

The inspection season this year was a great contrast to that of 1904, as rain interrupted the work every week, while living expenses (though not salaries) went on. As a result, the appropriation was so nearly expended that when a new nursery was learned of just after the close of the work there was not money enough left to make an inspection of it, and

it has necessarily been left for another season. When the present law was passed only thirty-two nurseries were known in Massachusetts, and even under those circumstances it was suggested that the appropriation should be made twice as great as that at which it was finally fixed. To-day we have almost four times as many nurseries to inspect as there were supposed to be then; and, as old ones are increasing their acreage and new ones are being started, the present appropriation is no longer sufficient. I would therefore recommend that the Legislature be requested to increase the appropriation for nursery inspection from the present sum of $1,000 to $1,200, and that the necessary steps to this end be taken at once.

FINANCIAL STATEMENT.

Appropriation,		$1,000 00
Compensation of State Nursery Inspector and three deputies,	$527 50	
Travelling and necessary expenses of inspector and deputies,	459 46	
Supplies (postage, etc.),	8 01	
Unexpended balance,	5 03	
		$1,000 00

Many inquiries for lists of Massachusetts nurseries are received each year, and, as the list printed two years ago is much out of date, it seems desirable to append to this report a revised list of the nurserymen of Massachusetts as now known.

In conclusion, I desire to express my hearty appreciation of the kindness shown to my deputies and to myself by the many persons with whom we have come in contact during the progress of the work this year, and to mention particularly the assistance and sympathy with it, which has been so often manifested by the secretary of the Board.

Respectfully submitted,

H. T. FERNALD,
State Nursery Inspector.

AMHERST, Dec. 30, 1905.

Appendix.

List of Nurserymen in Massachusetts.

Adams, J. W., & Co., Springfield.
Atkins, P. A., Pleasant Lake.
Barrows, H. E., Whitman.
Barrows, H. H., & Son, Whitman.
Beach, Joseph, South Hadley Falls.
Beals, E. B., Springfield.
Bemis, A. L., Worcester.
Boston Park Department, Jamaica Plain.
Brandley, James, Walpole.
Breed, E. W., Clinton.
Briggs, L. H., Smith's Ferry.
Brooks, H. N., South Yarmouth.
Casey, C., Melrose.
Chadbourne, A. H., Worcester.
Chase, Joseph S., Malden.
City Water Board, Cambridge.
Clapp, E. B., Dorchester.
Clark, Geo. A., Weston.
Clark, J. W., North Hadley.
Continental Nurseries, Franklin.
Cruickshanks, Geo., Fitchburg.
Cutler, Miss Mary E., Holliston.
Dighton Nursery Company, Dighton.
Draper, James, Worcester.
Dwyer, E. F., & Son, Lynn.
Eastern Nurseries, Jamaica Plain.
Elliott, W. H., Brighton.
Evans, H. D., Ayer.
Farquhar, R. & J., & Co., Boston.
Field, H. W., Northampton.
Fish, C. R., & Co., Worcester.
Fiske, C. D., Waltham.
Ford, J. P., East Weymouth.
Frost, G. Howard, West Newton.
Gates, W. A., Needham.
Geer, J. T., Three Rivers.
Gilbert, A. L., Springfield.
Gill, Mrs. E. M., Medford.
Gillett, Edw., Southwick.
Gordon, A. B., Randolph.
Gormley, E. W., Jamaica Plain.
Graves, R. B., Northampton.
Guinivan, D. H., Beverly.
Hastings, G. H., Fitchburg.
Heurlein, Julius, South Braintree.
Hitchcock, E. M., Agawam.
Horne, H. J., & Co., Haverhill.
Howard, J. W., Somerville.
Huebner, H., Groton.
Jahn, H. A., New Bedford.
Jennison, W. C., Natick.
Keen, Cyrus R., Cohasset.
King, R. B., Nantucket.
Kingman, C. D., Middleborough.
Lawrence, H. V., Falmouth.
Learned & Shirley, Danvers.
Lips, Herman, Bedford.
Lister, James, Stoneham.
Littlefield, Sidney, North Abington.
Macomber, F. S., Myricks.
Mann, H. W., Stoughton.
Manning, J. Woodward, Reading.
Massachusetts Agricultural College, Amherst.
Matthews, N., Jr., Hamilton.
McCormack, J. J., Malden.
McLaren, Anthony, Westwood.
McMannon, J. J., Lowell.
McMulkin, E., Norfolk Downs.
Mead, H. O., Lunenburg.
Miller, J. W., & Sons, Lynn.
Moseley, F. S. (O. C. Bailey, superintendent), Newburyport.
Mount Carmel Nurseries, Roslindale.
Mylott, J., Lowell.
Newton Cemetery Corporation, Newton.
Palmer, F. E., Brookline.
Patterson, J. W., Amesbury.
Patterson, Wm., Wollaston.
Payne, W. H., Newtonville.
Pease, L. H., Edgartown.
Peckham, S. S., Fairhaven.
Pfaffmann, M., Wollaston.
Phelps, F. H., Lee.

Pierce, Jesse, Beverly Farms.
Pratt, C. S., Reading.
Pratt, H. M., Concord.
Prince, F. H., Nantucket.
Quinn, Jas., Brookline.
Rea, F. J., Norwood.
Rhodes, A. A., Saugus.
Richards, E. A., Greenfield.
Richards, J. E., Needham.
Richards, J. L., Lunenburg.
Riley, Chas. N., New Bedford.
Robinson, D. A., Everett.
Robinson, L. D., Jr., Springfield.
Sawyer, F. P., Clinton.
Shady Hill Nursery Company, Boston.
Shaw, F. E., Rockland.
Southworth Brothers, Beverly.
Spinney, F. W., Haverhill.
Story, A. T., & Co., Berkley.
Sullivan & McGrath, Dorchester.
Sylvester, G. F., Hanover.
Thurlow, T. C., West Newbury.
Tuttle, A. M., Melrose Highlands.
Twomey, M. T., Roslindale.
Voornerveldt, H. H., Nantucket.
Walsh, M. H., Wood's Hole.
Walters, C., Roslindale.
Watson, T. R., Plymouth.
Wellesley Nursery Company, Wellesley.
White, A. T., Clifford P. O., New Bedford.
Whittet & Co., Lowell.
Whittier, W. B., & Co., South Framingham.
Willoughby, G. H., Edgartown.
Wood, Edw., Lexington.
Woodman, E. & C., Danvers.
Wright, G. B., Chelmsford.
Wyman, W. H., North Abington.
Yamanaka & Co., Boston.

EIGHTH SEMIANNUAL REPORT

OF THE

CHIEF OF THE CATTLE BUREAU

TO THE

MASSACHUSETTS

STATE BOARD OF AGRICULTURE.

JANUARY 10, 1906.

REPORT.

To the State Board of Agriculture.

The eighth semiannual report of the Chief of the Cattle Bureau, as required by section 3 of chapter 116 of the Acts of 1902, is herewith respectfully submitted to your honorable Board.

As the law requires that a report shall be made semiannually by the Chief of the Cattle Bureau to the State Board of Agriculture, it has been customary to submit a brief statement, at the summer meeting of the Board, of the prevalence of contagious animal diseases during the first half of the year, and means taken for their suppression; but that report is condensed as much as possible, and is intended to be preliminary to the report made at this meeting, in which a complete and detailed account is given of the work done during the preceding year.

The year of the Cattle Bureau commences December 16 of one year and closes December 15 of the following one, in order to allow sufficient time for closing the books and preparing the report in season to have it ready for your consideration at this meeting. Exceptions to the rule have been made this year by bringing the history of the outbreak of rabies up to Jan. 1, 1906, and also in the portion relating to glanders, where two or three cases entered on the books prior to December 16 were not disposed of until several days later, but as every case reported up to that date has now been settled, it seems better to include the final disposition of the animals in the year's report.

A financial statement is given below: —

Financial Statement.

Balance of appropriation for the year ending Dec. 31, 1904, as per report, Dec. 15, 1904,	$4,685 09	
Deficiency appropriation, under chapter 131, Acts of 1905,	5,000 00	
Total available for accounts of 1904,	$9,685 09	
Appropriation, under chapter 59, Acts of 1905, for salaries and expenses, etc.,	7,000 00	
Appropriation, under chapter 40, Acts of 1905, for general work of Bureau,	60,000 00	
Total to be accounted for,		$76,685 09

Expenditures for the year have been as follows: —

For cattle condemned and killed as tuberculous, 1,625 head, at an average appraisal of $21,	$34,133 58	
For killing and burial,	13 00	
For salary of Chief of Bureau,	1,800 00	
For expenses of Chief of Bureau,	123 69	
For salary of clerk,	1,200 00	
For assistant clerks and stenographers,	1,752 94	
For printing, postage, stationery and other office expenses,	1,866 34	
For services of agents (exclusive of glanders work),	11,039 97	
For expenses of agents (exclusive of glanders work),	4,838 83	
For laboratory and experimental work (exclusive of glanders work),	746 80	
For expenses of glanders work, including services and expenses of agents, laboratory work, and killing and burial,	7,167 21	
For expenses of quarantine stations at Brighton, Watertown and Somerville,	6,625 92	
For implements, ear tags, tuberculin, etc.,	882 66	
Total expenditures to Dec. 15, 1905,		72,190 94
Unexpended balance,		$4,494 15

Of this balance there remains from the deficit appropriation for bills of 1904,	$865 15
From appropriation for salaries, etc.,	828 12
Amount carried forward,	$1,693 27

Amount brought forward, . .	$1,693 27	
From appropriation for the general work of the Bureau, to be applied towards the payment of unsettled accounts for the year 1905, ...	2,800 88	
Total unexpended, as above, . .		$4,494 15
From sales of hides and carcasses of condemned animals, sales of ear tags, testing cattle at Brighton for non-resident owners, etc., there has been received and paid into the State treasury, ...		$3,233 57

Under chapter 220, Acts of 1903, twenty-four stamps for the use of inspectors of meats and provisions have been furnished to the boards of health of twenty-two different towns.

As the books are brought up only to December 16, it will be seen that there is a balance on hand of $2,800.88, left from the appropriation for the general work of the Cattle Bureau; but when the claims for cattle killed and various bills are brought in the first of the year this balance will be wiped out, and there will again be a deficiency to be provided for by the incoming Legislature.

The deficiency is again caused by not having sufficient money to carry out the law in paying owners for cattle killed as tuberculous. The 1st of October each year the inspectors of animals receive orders to make an inspection of the neat cattle and other farm animals in their respective cities and towns, together with the premises upon which neat cattle are kept, and to report upon the same in books provided for this purpose. The order requires them to complete the inspection by November 15, but some of the inspectors do not finish until two or three weeks later; and it is towards the end of this inspection, when quarantines upon cattle suspected of being tuberculous are being sent in rapidly, that the alternative presents itself of either having these animals destroyed by the State authority, or "released for lack of funds." In either case the Chief of the Cattle Bureau is the subject for criticism. If he releases diseased animals, he is found fault with for not having them killed, especially as many of them are milch cows, the product of which may be

unfit for human food; if, on the other hand, he orders them examined, and killed if found to be diseased, he is criticised for exceeding the appropriation made for the use of his department.

The past autumn and early winter it was decided to take all the tuberculous animals quarantined by the local inspectors prior to completing the general inspection; but after an inspector had completed his examinations and sent in his report, cattle quarantined by him subsequent thereto were "released for lack of funds," as it seemed that he ought to have found all the bad cases in his town during his annual tour of inspection.

Only 44 were released for lack of funds previous to Jan. 1, 1906, and most of these have been attended to since that date, as the law allows a department to expend one-twelfth of the amount of the previous year's appropriation each January, in anticipation that the Legislature will appropriate an equal amount one year to that of the preceding, in carrying out a given policy.

There have been 1,364 cattle killed and paid for out of the appropriation of 1905: the remaining 261 were paid for out of the deficiency appropriation made for 1904.

There are at present 580 cattle claims outstanding, which, at an average of $21 per head, will create a considerable deficiency.

The portion of the work of the Cattle Bureau involving the greatest outlay of money is connected with tuberculosis in cattle, therefore it will be, as usual, the disease first considered in this report, after submitting results of the annual examination of herds and premises made by inspectors of animals; but other diseases are quite as important, such as glanders and rabies. The chief feature of an unusual character occurring during 1905 has been the appearance of rabies, a detailed account of which is given under the proper heading. It has caused a great deal of extra work and expense, and has been the most serious outbreak that has occurred in this Commonwealth in many years, and possibly as bad as any in its history.

There seems to have been a distinct gain in connection with glanders, a full report of which appears further on.

Annual Inspection of Neat Cattle, Farm Animals, and Premises upon which the Former are kept, 1905.

Late in September the following circular letter was sent to the inspectors of animals in the cities and towns of the State, together with the necessary books in which to record the results of their work, and blank forms of certificates of health to be given owners in conformance with section 18, chapter 90, Revised Laws: —

Commonwealth of Massachusetts,
Cattle Bureau of the State Board of Agriculture,
Room 138, State House, Boston, Sept. 15, 1905.

Directions to Inspectors of Animals.

Inspectors of animals are hereby directed to make a general inspection of the neat stock in their respective towns, and incidentally other farm animals, to commence October 1 and to be completed before the fifteenth day of November, as required by chapter 90 of the Revised Laws.

Wherever inspectors examine animals and find them free from contagious disease they will give owners certificates of health, as provided for in section 18 of the law, from the book of blanks (Form No. 2) furnished for that purpose. Books will also be provided (Form No. 1) for carrying out the provisions of sections 17 and 24 of chapter 90 of the Revised Laws.

Inspectors will make a full and complete report on every place inspected, including all dimensions and measurements provided for on the blank, and answer in full all questions as to the light, ventilation, sanitary surroundings and water supply, as well as the number of cattle in the stable.

Inspectors of animals are not to quarantine any cattle as tuberculous unless they show sufficient evidence of disease to make it possible to condemn them on a physical examination. The only exception to be made is in case a milch cow shows evidence of tuberculosis of the udder; such an animal can be quarantined and the duplicate notice sent to this office.

It is also requested that, if cases of tuberculosis in animals are found, inspectors keep a record of them for a few days, and then when animals are quarantined several can be quarantined at once and duplicates sent here, so that the agent of the Cattle Bureau can see a number at one visit, instead of having to go every two or three days to see one animal at a time, thus avoiding running up expenses as much as possible.

It is also the duty of inspectors of animals to quarantine cattle brought into this State from without the limits of the Commonwealth, if the owner has not had a permit from this Bureau, the same to remain in quarantine until this office is furnished with a satisfactory certificate of tuberculin test.

Inspectors of animals are reminded that tuberculosis among cattle is not the only contagious disease with which they are called upon to deal, but in case they suspect the presence of any contagious disease among any species of domestic animals, they are to quarantine such animals and send duplicates to the Cattle Bureau office, in accordance with the provisions of section 19 of chapter 90 of the Revised Laws.

Section 28 of chapter 90 of the Revised Laws provides as follows: "Contagious diseases, under the provisions of this chapter, shall include glanders, farcy, contagious pleuro-pneumonia, tuberculosis, Texas fever, foot and mouth disease, rinderpest, hog cholera, rabies, anthrax or anthracoid diseases, sheep scab and actinomycosis."

As section 24 requires that the results of the inspection shall be incorporated in the annual report of the Chief of the Cattle Bureau to the State Board of Agriculture, it will be seen that it is necessary for the returns to be at this office by November 15, in order to prepare them for publication.

The necessary books for the inspection will be forwarded at once by mail or express. Please report immediately if not received by September 25.

AUSTIN PETERS,
Chief of Cattle Bureau.

The following table embodies a condensed report of the doings of the inspectors of animals in making the annual inspection, which complies with the requirements of section 24, chapter 90, Revised Laws: —

Report of Inspection of Animals, Stables, etc., required by Section 24, Chapter 90, Revised Laws.

City or Town.	Number Herds inspected.	Number Neat Cattle inspected.	Number Milch Cows inspected.	Number Herds kept Clean and in Good Condition.	Number Sheep inspected.	Number Swine inspected.	Number Goats inspected.	Number Stables inspected.	Number Stables well located.	Number Stables well lighted.	Number Stables well ventilated.	Number Stables kept Clean.	Number Stables with Good Water Supply.	Number Stables improved since Last Inspection.
Abington,	101	317	263	94	-	88	-	111	99	62	59	102	110	7
Acton,	112	1,327	789	110	11	87	-	138	137	118	137	137	133	59
Acushnet,	131	585	405	129	-	271	-	133	131	111	117	113	125	2
Adams,	88	890	640	78	31	325	-	74 [1]	65 [1]	40 [1]	63 [1]	64 [1]	73 [1]	5
Agawam,	179	1,538	1,087	177	-	580	1	187	165	169	176	184	185	18
Alford,	54	348	244	53	167	128	-	59	37	44	59	57	53	4
Amesbury,	110	549	364	98	12	153	-	110	101	97	105	97	109	7
Amherst,	70	941	679	67	-	190	-	77	74	61	63	74	74	-
Andover,	151	1,359	954	134	33	607	2	155	147	134	141	136	150	9
Arlington,	79	227	205	77	1	64	-	82	72	69	65	73	81	-
Ashburnham,	118	599	401	116	42	211	-	118	109	92	106	107	102	4
Ashby,	142	819	525	142	11	248	-	141	135	141	141	141	141	2
Ashfield,	159	1,592	785	2	1,230	241	13	179	154	153	167	169	178	3
Ashland,	88	439	291	81	1	125	1	93	88	77	79	82	83	1
Athol,	137	855	520	134	39	254	-	138	121	70	93	134	126	6

[1] Incomplete report.

Report of Inspection of Animals, Stables, etc. — Continued.

City or Town.	Number Herds inspected.	Number Neat Cattle inspected.	Number Milch Cows inspected.	Number Herds kept Clean and in Good Condition.	Number Sheep inspected.	Number Swine inspected.	Number Goats, inspected.	Number Stables inspected.	Number Stables well located.	Number Stables well lighted.	Number Stables well ventilated.	Number Stables kept Clean.	Number Stables with Good Water Supply.	Number Stables improved since Last Inspection.
Attleborough,	186	1,101	841	181	-	987	-	189	174	174	181	176	184	-
Auburn,	83	825	566	76	-	293	1	83	78	68	57	76	82	-
Avon,	47	168	153	46	7	40	1	47	38	26	35	41	45	3
Ayer,	24	124	87	23	-	69	-	26	22	26	25	25	26	-
Barnstable,	224	607	444	220	38	440	2	225	213	223	223	219	221	-
Barre,	111	2,317	1,353	101	19	233	-	120	114	107	119	109	120	33
Becket,	75	520	264	74	201	95	100	78	53	72	77	77	77	3
Bedford,	65	692	429	64	6	1,816	4	66	42	62	65	63	66	2
Belchertown,	303	2,343	1,444	294	11	502	-	330	309	280	313	317	328	-
Bellingham,	89	679	465	84	-	95	-	107	102	48	72	91	107	13
Belmont,	27	217	182	26	-	102	1	28	27	18	20	25	28	3
Berkley,	106	452	330	106	2	159	-	106	94	101	104	106	106	-
Berlin,	89	712	438	80	74	74	-	94	88	75	84	94	92	7
Bernardston,	91	820	473	55	196	267	-	92	89	45	3	45	90	-
Beverly,	39	623	506	38	-	93	-	39	39	32	38	38	39	3
Billerica,	145	992	734	143	-	325	-	145	141	135	127	138	133	24

Blackstone, ...	194	1,104	783	186	–	344	–	201	196	158	158	184	195	–
Blandford, ...	91	1,105	519	89	83	120	–	119	94	87	119	115	114	2
Bolton, ...	102	935	587	63	6	186	–	106	92	71	81	66	102	–
Boston, ...	288	1,240	1,128	278	331	545	–	296	256	220	240	268	276	1
Bourne, ...	68	166	127	53	–	41	1	68	67	68	67	68	67	–
Boxborough, ...	46	651	349	44	18	168	80	49	47	48	43	47	47	20
Boxford, ...	64	641	396	61	13	133	–	70	58	54	65	67	64	–
Boylston, ...	64	741	442	64	–	315	6	66	63	62	64	61	66	–
Braintree, ...	94	448	377	92	–	148	–	96	83	87	88	85	95	–
Brewster, ...	91	179	115	89	52	132	–	92	71	88	92	78	91	–
Bridgewater, ...	173	824	596	157	25	657	–	175	160	127	129	155	174	5
Brimfield, ...	113	1,136	645	112	79	167	2	113	108	73	91	106	113	1
Brockton, ...	94	894	712	86	9	819	–	102	90	91	83	74	98	–
Brookfield, ...	139	950	568	123	30	262	–	148	142	117	144	123	137	2
Brookline, ...	64	372	287	58	–	54	50	69	49	50	45	50	61	1
Buckland, ...	126	1,142	535	106	394	243	–	148	130	91	18	114	147	5
Burlington, ...	49	551	407	47	–	3,165	–	49	48	49	49	49	49	2
Cambridge, ...	37	137	126	32	–	–	–	42	27 [1]	29 [1]	31 [1]	23 [1]	3 [1]	–
Canton, ...	126	605	417	122	–	372	–	127	115	103	112	123	125	6
Carlisle, ...	51	581	403	43	–	44	–	54	52	39	51	41	52	–
Carver, ...	88	169	122	87	18	53	1	88	84	83	78	79	82	–
Charlemont, ...	80	749	498	71	294	131	–	89	75	57	85	84	89	–

[1] Incomplete report.

Report of Inspection of Animals, Stables, etc. — Continued.

City or Town.	Number Herds inspected.	Number Neat Cattle inspected.	Number Milch Cows inspected.	Number Herds kept Clean and in Good Condition.	Number Sheep inspected.	Number Swine inspected.	Number Goats inspected.	Number Stables inspected.	Number Stables well located.	Number Stables well lighted.	Number Stables well ventilated.	Number Stables kept Clean.	Number Stables with Good Water Supply.	Number Stables improved since Last Inspection.
Charlton,	169	1,782	1,017	168	22	342	-	174	173	166	167	169	138	5
Chatham,	74	172	128	72	-	149	-	74	56	72	73	73	74	6
Chelmsford,	63	820	596	54	-	243	-	70	70	53	67	45	63	9
Chelsea,	22	214	181	20	-	47	6	23	22	17	19	20	21	3
Cheshire,	76	1,218	790	42	67	427	-	97	80	59	61	50	89	1
Chester,	87	759	335	86	432	180	-	117	92	61	89	115	116	-
Chesterfield,	98	1,030	473	94	-	197	-	134	98	89	100	116	132	4
Chicopee,	79	645	486	62	-	234	-	85	71	54	72	67	66	2
Chilmark,	58	277	102	57	2,117	70	-	52	50	33	52	52	52	4
Clarksburg,	50	315	217	48	-	102	-	52	46	37	46	35	50	2
Clinton,	39	91	74	39	-	26	-	40	36	24	30	37	38	7
Cohasset,	113	305	253	60	2	134	1	117	92	62	80	71	49	7
Colrain,	145	1,791	823	122	811	335	-	149	139	133	144	143	148	3
Concord,	150	1,786	1,098	141	2	654	3	161	154	152	151	159	160	-
Conway,	97	1,553	733	30 [1]	775	360	-	93	59	74	87	85	87	2
Cottage City,	37	144	112	37	16	171	-	37	36	34	37	37	17	1

Cummington,	96	785	482	88	113	92	75	102	77	61	94	90	102	1
Dalton,	33	655	409	31	157	327	-	40	25	40	40	40	39	1
Dana,	69	353	192	67	4	90	-	69	68	45	67	65	69	-
Danvers,	78	1,017	712	76	-	86	-	84	79	84	84	84	83	-
Dartmouth,	231	2,127	1,566	219	325	560	4	242	196	178	169	225	216	18
Dedham,	94	563	481	84	-	429	5	97	82	75	81	83	95	4
Deerfield,	125	1,147	748	108	145	394	-	136	115	62	115	125	136	6
Dennis,	97	225	150	79	-	91	-	98	83	75	86	82	51	-
Dighton,	111	492	336	109	32	215	-	114	111	101	102	114	113	-
Douglas,	109	378	272	101	-	166	-	108	47	72	100	76	107	-
Dover,	52	559	442	36	-	297	5	53	49	31	29	31	52	-
Dracut,	159	1,220	1,117	141	3	1,416	1	171	160	61	112	114	154	6
Dudley,	94	1,079	828	91	-	136	-	94	90	64	90	87	93	10
Dunstable,	25	300	177	25	7	54	1	25	24	23	25	25	25	2
Duxbury,	146	398	283	146	27	211	-	146	129	124	146	138	146	1
East Bridgewater,	167	705	541	151	-	439	4	196	184	167	186	185	192	34
East Longmeadow,	78	533	358	54	-	131	-	78	63	50	75	74	78	-
Eastham,	63	150	93	54	-	108	-	63	57	43	43	59	48	2
Easthampton,	130	985	587	118	-	335	-	130	110	127	130	130	130	-
Easton,	169	812	604	168	4	30	-	178	159	156	176	172	167	-
Edgartown,	52	234	162	52	797	200	-	56	56	56	56	56	56	2
Egremont,	89	879	658	89	189	139	30	94	57	93	94	93	94	7

[1] Incomplete report.

Report of Inspection of Animals, Stables, etc. — Continued.

City or Town.	Number Herds inspected.	Number Neat Cattle inspected.	Number Milch Cows inspected.	Number Herds kept Clean and in Good Condition.	Number Sheep inspected.	Number Swine inspected.	Number Goats inspected.	Number Stables inspected.	Number Stables well located.	Number Stables well lighted.	Number Stables well ventilated.	Number Stables kept Clean.	Number Stables with Good Water Supply.	Number Stables improved since Last Inspection.
Enfield,	92	583	350	89	70	102	4	93	83	74	93	88	93	–
Erving,	40	171	112	39	–	66	1	40	31	36	39	38	35	2
Essex,	71	656	420	70	3	109	1	71	70	69	71	67	68	–
Everett,	40	220	207	38	–	909	2	44	37	38	39	38	33	4
Fairhaven,	111	582	421	91	–	25	–	115	115	34	24	86	22	–
Fall River,	82	429	327	76	2	265	–	83	49	75	72	70	81	–
Falmouth,	168	425	346	166	–	270	–	168	147	105	148	152	157	–
Fitchburg,	150	1,057	649	136	–	385	–	164	156	100	112	124	161	1
Florida,	68	512	296	63	10	243	–	73	63	65	72	68	73	1
Foxborough,	133	522	364	128	2	386	26	135	133	130	126	130	133	–
Framingham,	212	1,639	1,142	209	20	407	150	222	192	215	220	219	178	1
Franklin,	133	732	599	128	–	152	–	141	135	118	133	135	120	–
Freetown,	112	314	218	105	–	98	1	124	115	59	83	112	89	2
Gardner,	82	706	451	71	94	269	–	83	73	54	58	71	82	2
Gay Head,	19	79	22	19	–	20	–	20	14	5	6	19	19	–
Georgetown,	86	346	197	79	–	133	22	86	82	69	84	76	86	–

Gill,	62	814	463	45	37	339	-	84	70	54	79	67	79	5
Gloucester,	113	683	550	99	-	223	-	121	115	66	65	68	35	6
Goshen,	48	435	204	38	65	126	-	59	54	43	53	52	55	1
Gosnold,	9	49	30	9	2,220	23	2	8	8	7	6	8	7	-
Grafton,	152	1,526	1,023	145	120	517	2	160	146	152	150	150	159	4
Granby,	125	1,348	1,004	124	7	212	1	141	139	130	140	137	141	3
Granville,	125	982	506	124	110	322	1	124	112	115	119	123	124	-
Great Barrington,	144	1,630	1,062	138	-	655	3	163	94	152	153	160	162	-
Greenfield,	149	1,246	776	145	437	430	-	150	132	137	138	144	150	-
Greenwich,	68	426	258	68	-	144	-	70	67	58	66	69	61	-
Groton,	142	1,015	611	91	91	134	-	148	145	95	131	95	85	6
Groveland,	61	357	228	54	37	75	-	66	65	59	62	57	66	-
Hadley,	195	1,807	1,043	160	77	613	-	265	245	200	252	242	249	4
Halifax,	67	178	123	66	7	54	-	67	36	67	66	67	67	-
Hamilton,	60	364	246	58	4	138	-	65	63	52	61	57	64	3
Hampden,	79	633	372	78	16	124	-	89	79	87	88	87	87	1
Hancock,	66	756	436	61	580	238	-	103	56	54	101	90	103	3
Hanover,	125	337	264	122	-	190	-	126	115	125	125	125	126	-
Hanson,	92	203	153	88	-	186	-	91	85	88	91	87	91	9
Hardwick,	121	2,246	1,447	116	-	443	-	126	123	75	103	117	125	5
Harvard,	142	1,549	883	105	53	59	-	163	163	144	161	137	148	45
Harwich,	133	235	182	132	1	135	2	132	117	108	132	132	132	6

Report of Inspection of Animals, Stables, etc. — Continued.

City or Town.	Number Herds inspected.	Number Neat Cattle inspected.	Number Milch Cows inspected.	Number Herds kept Clean and in Good Condition.	Number Sheep inspected.	Number Swine inspected.	Number Goats inspected.	Number Stables inspected.	Number Stables well located.	Number Stables well lighted.	Number Stables well ventilated.	Number Stables kept Clean.	Number Stables with Good Water Supply.	Number Stables improved since Last Inspection.
Hatfield,	125	372	314	124	-	177	-	126	121	125	125	126	126	-
Haverhill,	221	1,293	940	197	-	169	24	221	213	72	72	167	81	1
Hawley,	75	787	380	38	216	162	-	93	82	34	46	50	87	1
Heath,	82	973	388	79	305	202	-	106	71	97	105	105	95	-
Hingham,	157	636	483	154	-	276	-	167	139	165	165	165	167	-
Hinsdale,	93	889	494	83	69	208	1	95	51	65	65	89	93	8
Holbrook,	73	244	161	70	1	298	1	74	66	68	68	69	71	-
Holden,	92	826	522	71	-	121	-	95	82	50	49	70	16	-
Holland,	35	236	93	34	29	109	-	42	32	25	39	40	34	4
Holliston,	120	747	538	119	3	71	-	122	115	119	118	117	117	2
Holyoke,	76	790	503	62	1	235	-	85	34	39	43	34	32	2
Hopedale,	25	113	85	25	-	25	-	26	25	22	25	26	24	-
Hopkinton,	136	680	477	78	-	189	-	138	135	73	67	84	128	9
Hubbardston,	124	930	533	112	10	190	375	131	114	95	103	106	127	13
Hudson,	45	349	210	37	-	124	-	45	42	36	39	38	45	1
Hull,	17	70	57	16	-	2	-	17	11	9	8	13	-	-

Huntington, . . .	99	813	339	88	203	247	-	107	90	98	106	89	101	2
Hyde Park, . . .	18	59	47	2	-	-	-	18	18	10	7	15	18	-
Ipswich, ...	135	954	615	135	16	388	5	141	133	115	141	141	139	5
Kingston, . . .	93	263	182	90	15	230	5	97	89	68	71	74	97	1
Lakeville, . . .	98	392	228	91	7	188	-	99	97	79	80	77	99	13
Lancaster, . . .	79	664	445	73	10	190	-	81	76	65	75	70	66	1
Lanesborough, . .	111	1,152	793	111	16	213	-	113	82	111	113	113	113	-
Lawrence, . . .	14	102	76	12	-	85	-	14	12	12	13	14	14	-
Lee, ...	180	977	637	179	240	364	-	186	143	176	180	184	161	1
Leicester, . . .	11	187	142	70	-	519	-	79	74	74	77	78	79	1
Lenox, ...	23	365	251	21	-	100	-	23	14	18	17	23	23	1
Leominster, . . .	98	987	647	42	10	383	-	118	111	66	82	50	85	1
Leverett, ...	98	609	333	89	34	272	-	110	101	85	102	100	88	15
Lexington, . . .	73	1,021	861	72	2	531	2	79	72	32	41	69	77	3
Leyden, ...	73	713	311	70	515	191	-	79	60	57	74	79	79	-
Lincoln, ...	87	936	707	80	4	580	-	89	77	60	76	60	82	5
Littleton, . . .	80	1,548	851	80	4	96	12	80	80	77	80	80	75	-
Longmeadow, . .	51	330	214	50	-	447	-	57	46	51	55	56	57	4
Lowell, ...	47	351	299	46	2	244	-	47	42	34	38	43	42	-
Ludlow, ...	127	864	724	123	25	490	1	136	109	89	127	121	120	1
Lunenburg, . . .	127	1,122	760	121	21	214	-	137	133	99	135	124	135	2
Lynn, ...	83	307	243	63	2	227	1	84	81	64	82	58	84	7

Report of Inspection of Animals, Stables, etc. — Continued.

City or Town.	Number Herds inspected.	Number Neat Cattle inspected.	Number Milch Cows inspected.	Number Herds kept Clean and in Good Condition.	Number Sheep inspected.	Number Swine inspected.	Number Goats inspected.	Number Stables inspected.	Number Stables well located.	Number Stables well lighted.	Number Stables well ventilated.	Number Stables kept Clean.	Number Stables with Good Water Supply.	Number Stables improved since Last Inspection.
Lynnfield, ...	30	358	284	29	–	96	1	31	29	30	31	30	30	–
Malden, ...	34	175	152	30	–	–	1	36	34	20	15	18	36	3
Manchester, . . .	28	104	84	28	–	48	–	29	24	29	28	29	29	–
Mansfield, . . .	114	378	265	98	–	228	3	117	18 [1]	17 [1]	20 [1]	92 [1]	117	–
Marblehead, . . .	49	367	283	44	–	641	1	50	43	22	23	42	15	12
Marion, ...	51	153	114	48	1	178	2	51	50	35	41	42	49	
Marlborough, . .	189	1,181	819	181	3	382	–	194	188	170	180	173	183	26
Marshfield, . . .	146	523	337	144	5	161	1	149	133	87	125	138	136	3
Mashpee, ...	16	19	18	16	–	30	–	16	14	16	16	16	16	–
Mattapoisett, . . .	74	251	168	70	2	245	24	74	72	64	72	69	74	3
Maynard, ...	31	259	167	26	–	88	2	32	30	26	25	30	32	–
Medfield, ...	70	593	375	70	–	519	–	79	74	74	77	78	79	1
Medford, ...	75	392	348	75	–	28	–	75	65	65	68	73	73	–
Medway, ...	117	564	370	112	–	152	–	123	115	102	98	103	121	49
Melrose, ...	45	136	119	27	–	–	–	46	38	28	17	21	44	–
Mendon, ...	94	642	431	79	–	131	1	104	100	63	63	84	95	5

Merrimac,	58	325	211	51	2	54	-	52	48	43	28	42	39	-
Methuen,	165	1,568	1,117	88	40	639	-	171	162	103	111	88	171	16
Middleborough,	315	1,062	697	289	16	575	9	320	282	262	261	259	309	-
Middlefield,	45	515	201	42	275	101	-	51	35	30	50	50	49	-
Middleton,	55	373	273	46	-	149	1	61	60	53	50	46	59	-
Milford,	142	522	383	139	-	374	4	143	133	115	110	128	141	6
Millbury,	129	961	644	115	-	192	16	132	103	116	125	122	126	4
Millis,	64	720	437	57	6	50	-	70	61	52	61	59	70	9
Milton,	121	905	735	120	-	253	-	123	104	123	123	123	123	2
Monroe,	23	167	86	23	50	41	-	25	23	24	24	25	25	2
Monson,[1]	197	1,563	952	181	59	390	1	241	217	155	168	181	233	2
Montague,	138	917	532	119	87	386	1	143	127	71	96	112	126	5
Monterey,	69	560	313	64	221	154	-	70	38	52	64	67	70	1
Montgomery,	46	456	255	44	65	84	-	47	39	45	46	47	47	-
Mount Washington,	16	89	61	14	-	26	8	16	11	9	11	16	16	1
Nahant,	11	37	35	9	-	3	-	11	11	9	11	11	11	-
Nantucket,	89	558	391	86	154	172	18	91	88	76	90	89	78	-
Natick,	85	658	501	73	-	269	-	85	81	55	43	65	83	-
Needham,	108	812	621	106	-	225	-	114	95	58	94	101	113	-
New Ashford,	27	176	127	25	275	56	-	25	20	24	24	24	25	-
New Bedford,	66	478	373	65	-	95	-	65	64	57	61	65	64	-
New Braintree,	75	1,544	1,085	75	-	125	-	75	75	71	71	71	75	2

[1] Incomplete report.

Report of Inspection of Animals, Stables, etc. — Continued.

City or Town.	Number Herds inspected.	Number Neat Cattle inspected.	Number Milch Cows inspected.	Number Herds kept Clean and in Good Condition.	Number Sheep inspected.	Number Swine inspected.	Number Goats inspected.	Number Stables inspected.	Number Stables well located.	Number Stables well lighted.	Number Stables well ventilated.	Number Stables kept Clean.	Number Stables with Good Water Supply.	Number Stables improved since Last Inspection.
New Marlborough,	109	1,378	765	92	343	138	18	131	91	83	69	119	120	-
New Salem,	116	532	305	111	79	232	-	124	112	120	124	120	124	2
Newbury,	120	1,601	832	119	81	304	1	199	182	173	193	198	156	-
Newburyport,	90	468	294	89	-	214	2	100	94	98	98	99	99	8
Newton,	222	1,194	1,127	222	-	-	-	228	182	202	207	210	228	-
Norfolk,	63	420	259	58	-	276	-	63	61	61	58	62	61	3
North Adams,	47	677	446	47	56	167	60	47	36	47	47	47	47	-
North Andover,	71	1,067	754	69	25	247	-	71	68	69	70	71	71	1
North Attleborough,	124	713	600	99	-	332	-	133	117	96	109	105	122	7
North Brookfield,	136	1,316	815	112	-	313	-	141	130	96	139	113	127	7
North Reading,	62	576	383	61	-	-	-	62	58	58	62	58	62	4
Northampton,	51	770	515	49	-	248	-	54	40	40	53	51	54	1
Northborough,	130	1,254	791	106	-	136	1	138	132	109	45	125	136	38
Northbridge,	91	571	393	88	15	113	-	102	99	93	102	96	101	-
Northfield,	88	773	483	85	-	173	-	88	85	63	86	87	88	1
Norton,	151	469	327	151	17	194	1	152	134	140	146	151	151	-

Norwell,	103	244	191	100	52	135	-	103	98	71	101	100	103	1
Norwood,	80	403	314	79	-	70	-	86	81	81	79	84	86	1
Oakham,	57	642	411	50	-	81	-	65	60	39	31	51	43	5
Orange,	188	1,155	702	179	37	444	-	200	177	171	171	183	200	2
Orleans,	77	155	127	73	23	75	-	- [1]	- [1]	- [1]	- [1]	- [1]	- [1]	-
Otis,	89	568	256	89	223	264	-	101	81	98	101	101	101	1
Oxford,	124	794	475	116	33	286	301	124	111	84	105	95	116	4
Palmer,	138	937	634	130	-	-	-	100	84	76	87	99	99	-
Paxton,	62	547	383	59	2	51	-	62	57	46	54	59	62	-
Peabody,	59	851	739	58	15	669	-	61	54	57	61	59	61	7
Pelham,	36	156	97	34	15	33	-	36	33	13	19	35	36	-
Pembroke,	108	242	164	101	-	177	2	107	104	105	105	104	105	-
Pepperell,	136	883	630	133	6	176	-	150	143	119	120	144	148	34
Peru,	55	422	223	35	79	48	-	54	52	54	53	54	54	-
Petersham,	111	883	467	93	112	267	-	116	107	57	66	92	109	5
Phillipston,	68	519	324	67	-	97	-	73	73	40	18	70	71	-
Pittsfield,	67	1,261	846	60	55	239	2	70	67	43	40	53	68	-
Plainfield,	73	761	337	69	61	234	2	97	86	50	81	87	81	3
Plainville,	56	294	207	54	-	81	1	58	57	47	49	52	55	1
Plymouth,	177	496	353	104	22	858	17	180	145	36	79	103	125	3
Plympton,	64	256	162	63	-	53	-	70	65	60	55	65	53	-
Prescott,	64	495	252	63	10	143	-	73	71	60	70	67	44	1

[1] Incomplete report.

Report of Inspection of Animals, Stables, etc. — Continued.

City or Town.	Number Herds inspected.	Number Neat Cattle inspected.	Number Milch Cows inspected.	Number Herds kept Clean and in Good Condition.	Number Sheep inspected.	Number Swine inspected.	Number Goats inspected.	Number Stables inspected.	Number Stables well located.	Number Stables well lighted.	Number Stables well ventilated.	Number Stables kept Clean.	Number Stables with Good Water Supply.	Number Stables improved since Last Inspection.
Princeton, ...	97	1,145	679	69	113	195	9	101	99	82	80	65	100	10
Provincetown, . . .	13	102	75	13	2	23	-	13	13	12	3	11	4	-
Quincy, ...	90	571	492	79	7	97	2	92	83	80	78	81	88	-
Randolph, . . .	100	340	280	100	-	878	1	105	97	88	93	79	98	-
Raynham, . . .	142	609	459	140	4	214	-	144	138	114	134	137	143	10
Reading, ...	75	356	287	73	2	64	1	76	73	73	75	76	76	-
Rehoboth, . . .	239	1,594	1,275	233	22	446	-	240	214	107	119	165	225	4
Revere, ...	35	166	154	34	1	500	-	39	39	39	32	39	39	1
Richmond, . . .	85	595	368	85	449	227	-	85	66	72	84	85	85	3
Rochester, . . .	91	314	202	83	-	195	-	91	84	52	86	81	88	-
Rockland, . . .	113	272	202	96	-	90	1	114	104	72	65	72	112	2
Rockport, . . .	49	223	187	46	-	112	-	49	46	43	43	44	49	-
Rowe, ...	65	565	263	65	190	110	-	70	52	53	63	69	68	1
Rowley, ...	76	637	332	54	8	90	-	80	50	57	59	54	75	2
Royalston, . . .	96	882	445	89	17	191	-	96	92	96	96	94	96	5
Russell, ...	48	260	98	45	102	95	1	54	41	30	46	39	54	3
Rutland, ...	107	1,016	616	103	-	309	-	134	123	112	132	119	134	16

Salem, ...	12	303	254	11	-	330	-	12	10	8	7	11	12	-
Salisbury, . . .	120	592	342	118	4	135	1	122	108	110	112	112	107	3
Sandisfield, . . .	108	1,041	520	96	90	157	-	124	85	77	124	112	112	2
Sandwich, . . .	88	276	165	78	28	106	-	86	80	79	82	82	80	-
Saugus, ...	44	897	773	43	-	122	-	57	54	50	51	57	57	-
Savoy, ...	99	655	373	86	82	151	-	108	90	42	52	83	90	1
Scituate, ...	128	379	271	127	6	156	-	129	113	102	120	117	128	-
Seekonk, ...	137	1,094	809	118	25	1,741	2	146	123	95	131	125	128	7
Sharon, ...	74	312	240	71	-	31	-	75	60	67	74	73	61	5
Sheffield, ...	190	2,099	1,428	133	216	477	-	219	157	132	214	210	155	7
Shelburne, . . .	107	1,577	680	92	753	208	-	110	94	98	107	105	106	5
Sherborn, . . .	78	991	683	73	-	642	16	80	73	66	70	71	74	18
Shirley, ...	61	362	257	58	29	77	6	67	67	61	61	63	67	-
Shrewsbury, . . .	131	1,532	1,028	129	6	504	-	135	124	119	112	124	135	6
Shutesbury, . . .	30	142	88	29	4	53	-	32	31	32	32	31	31	-
Somerset, ...	81	586	472	79	2	469	2	82	76	80	82	81	73	-
Somerville, . . .	36	109	104	31	2	160	3	36	33	21	19	27	36	10
South Hadley, . .	103	1,299	979	91	1	227	-	124	113	100	105	93	124	-
Southampton, . . .	142	1,280	721	135	58	278	-	155	127	133	136	147	150	8
Southborough, . .	91	1,167	899	85	154	120	-	106	106	103	105	83	106	2
Southbridge, . . .	120	855	514	94	36	170	2	120	108	62	79	80	88	5
Southwick, . . .	131	1,032	681	124	210	267	21	141	123	104	134	134	138	-

Report of Inspection of Animals, Stables, etc. — Continued.

City or Town.	Number Herds inspected.	Number Neat Cattle inspected.	Number Milch Cows inspected.	Number Herds kept Clean and in Good Condition.	Number Sheep inspected.	Number Swine inspected.	Number Goats inspected.	Number Stables inspected.	Number Stables well located.	Number Stables well lighted.	Number Stables well ventilated.	Number Stables kept Clean.	Number Stables with Good Water Supply.	Number Stables improved since Last Inspection.
Spencer,	144	1,474	876	137	10	301	14	149	144	142	147	141	148	1
Springfield,	155	528	354	122	16	883	8	144	106	71	113	118	84	-
Sterling,	143	1,740	1,225	138	67	206	-	148	142	114	113	123	143	-
Stockbridge,	101	814	475	79	255	183	2	108	58	55	52	93	98	-
Stoneham,	73	289	250	59	-	291	3	77	47	32	27	54	51	-
Stoughton,	123	498	365	97	-	35	10	130	105	78	112	105	128	-
Stow,	88	977	556	29	35	112	28	115	108	59	69	56	96	-
Sturbridge,	12	104	69	12	11	30	-	12	11	10	12	12	12	-
Sudbury,	80	1,124	772	73	1	138	-	90	40	90	86	88	82	1
Sunderland,	71	680	440	47	-	431	-	76	76	26	22	30	58	7
Sutton,	172	1,272	811	126	38	425	4	182	161	74	34	110	146	-
Swampscott,	24	99	87	24	-	25	-	24	19	22	23	24	24	1
Swansea,	127	1,023	725	122	3	556	-	137	133	133	132	134	135	-
Taunton,	149	1,185	897	100	4	1,005	4	149	143	83	67	89	149	4
Templeton,	119	609	386	103	5	108	1	122	118	114	118	114	115	3
Tewksbury,	139	879	608	128	-	1,005	6	149	141	68	101	119	125	2
Tisbury,	22	89	67	19	-	67	-	22	21	19	19	20	22	1

Tolland,	43	485	263	30	2	97	-	60	48	38	53	54	57	5
Topsfield,	78	733	502	69	-	161	3	86	78	69	72	71	75	3
Townsend,	141	543	366	119	5	390	-	143	138	134	134	131	132	13
Truro,	70	246	183	70	-	72	-	70	54	68	69	69	69	3
Tyngsborough,	55	431	333	27	20	354	-	59	23	20	25	25	40	6
Tyringham,	60	545	274	55	181	149	-	81	81	68	81	78	80	6
Upton,	109	641	400	31	-	276	-	117	109	80	22	95	107	10
Uxbridge,	137	818	518	133	8	258	63	145	141	136	145	138	127	5
Wakefield,	79	316	273	67	6	376	-	84	66	72	73	72	76	1
Wales,	62	238	155	27	28	84	-	64	51	34	51	59	47	-
Walpole,	99	549	389	94	22	644	3	99	88	30	86	94	94	4
Waltham,	43	872	655	41	7	811	2	43	42	35	36	37	12	1
Ware,	145	1,110	743	62	2	357	2	148	138	33	31	11	148	4
Wareham,	58	252	211	58	-	97	-	58	26	58	58	58	58	-
Warren,	133	1,963	1,040	131	27	304	1	151	136	93	30	141	126	50
Warwick,	78	357	194	60	21	114	-	79	72	66	75	79	78	2
Washington,	50	658	281	38	237	243	64	67	35	39	60	54	57	-
Watertown,	60	358	336	56	2	169	-	62	54	33	43	58	62	1
Wayland,	75	855	591	74	-	929	1	78	28	64	66	77	66	-
Webster,	23	218	178	23	-	12	-	24	23	15	17	23	21	-
Wellesley,	65	231	184	62	-	56	-	65	59	30	56	60	65	-
Wellfleet,	39	96	67	31	-	26	-	39	20	23	35	34	38	-

Report of Inspection of Animals, Stables, etc. — Concluded.

City or Town.	Number Herds inspected.	Number Neat Cattle inspected.	Number Milch Cows inspected.	Number Herds kept Clean and in Good Condition.	Number Sheep inspected.	Number Swine inspected.	Number Goats inspected.	Number Stables inspected.	Number Stables well located.	Number Stables well lighted.	Number Stables well ventilated.	Number Stables kept Clean.	Number Stables with Good Water Supply.	Number Stables improved since Last Inspection.
Wendell,	52	257	131	52	22	151	-	55	46	46	51	54	55	1
Wenham,	54	350	282	47	-	361	2	59	55	36	35	48	59	-
West Boylston,	84	856	582	80	6	398	1	100	94	88	98	94	98	17
West Bridgewater,	47	741	528	46	6	128	4	48	10	46	44	45	47	-
West Brookfield,	88	1,352	680	60	32	172	20	94	84	84	84	83	83	1
West Newbury,	94	933	591	94	7	287	-	102	52	101	101	96	100	-
West Springfield,	125	893	623	121	1	2,403	-	125	119	113	113	112	125	-
West Stockbridge,	122	509	370	122	428	345	1	122	79	97	97	119	119	-
West Tisbury,	55	234	172	52	958	113	-	63	54	58	58	57	58	-
Westborough,	159	1,893	1,147	154	2	727	4	166	156	123	131	150	164	20
Westfield,	215	1,498	917	211	-	551	-	239	214	235	236	236	239	6
Westford,	110	1,053	674	88	-	301	-	121	119	92	104	67	120	18
Westhampton,	74	736	390	46	1	235	-	81	44	40	73	54	67	-
Westminster,	85	579	431	83	5	-	-	87	77	56	7	80	-[1]	1
Weston,	119	1,001	700	118	40	475	-	127	117	118	122	110	126	-
Westport,	303	1,452	1,006	279	22	435	18	307	291	188	234	278	293	11
Westwood,	67	506	418	65	-	501	76	71	61	62	62	64	64	-

Weymouth,	201	764	658	140	1	605	-	201	170	137	106	99	198	6
Whately,	112	902	523	108	34	304	-	129	122	104	126	127	129	7
Whitman,	88	372	308	79	17	114	-	88	72	66	69	77	83	-
Wilbraham,	115	959	558	108	-	238	-	120	94	101	98	96	114	-
Williamsburg,	91	801	396	74	-	150	-	92	82	38	54	70	85	-
Williamstown,	187	1,550	992	137	1,102	579	1	187	167	114	101	165	182	23
Wilmington,	89	275	196	81	-	183	10	89	75	47	35	78	88	6
Winchendon,	142	646	451	138	39	287	-	149	135	145	148	140	148	40
Winchester,	21	229	189	15	-	50	-	22	19	17	18	20	22	-
Windsor,	85	1,039	574	82	138	232	-	111	86	73	92	111	93	2
Winthrop,	17	48	44	17	-	-	-	17	17	17	17	17	17	-
Woburn,	93	320	268	91	-	155	-	93	87	88	89	90	91	2
Worcester,	313	2,266	1,813	311	75	4,029	2	310	302	304	307	309	310	7
Worthington,	97	884	492	72	127	169	15	109	79	90	105	95	107	-
Wrentham,	93	336	224	66	-	94	-	93	86	46	41	65	69	3
Yarmouth,	57	138	109	52	35	83	-	57	54	53	54	54	56	-
	32,767	230,140	143,362	30,630	24,720	105,805	1,990	35,921	29,550	27,318	29,899	31,510	33,284	1,344

[1] Incomplete report.

While the number of herds given is less than in 1904, as well as the number of neat cattle and milch cows, the reports in many ways are more complete. They show an increase of over 700 sheep and a decrease of over 600 goats. Every city and town has been heard from, although it was long after November 15 when the reports of some of the inspectors were received.

The number of stables inspected exceeds those of the previous year by about 5,000, and the returns are more complete than for several years; only five towns are marked as incomplete on the stable inspection, and in these the omissions were few and trivial. The better stable inspection was brought about by inserting in the inspection books a new series of questions relating to stables, rendering it impossible for inspectors to write "the same as last year" in filling out the answers, as has been the case for several previous years with many of them.

While it is felt that in some towns the inspectors have not made as thorough and complete an inspection as it was possible for them to make, yet it is not to be wondered at if the work is not performed in the best possible manner, when the compensation they receive in many of the smaller towns of the State is considered. Inspectors of animals in some of the small towns receive but $15 to $20 per annum; and when one considers the salary in comparison with the services required, there can be no doubt but what the compensation is more than earned in the amount of work done, even although it is not carried out to the fullest completion.

It is still a matter worthy of consideration as to whether it would not be better for the State to be divided into veterinary districts, with a veterinarian under the direction of the Chief of the Cattle Bureau in charge of each, with a suitable salary from the State, rather than to continue the present system of town inspectors of animals.

Tuberculosis.

That portion of the duties of the Cattle Bureau required in connection with tuberculosis may be divided, as in preceding years, under three heads.

First. — That part of the work resulting from the action of the local inspectors of animals quarantining cattle suspected of having tuberculosis, which must be examined by agents of the Cattle Bureau, and appraised and killed if found to be suffering from the disease, or released if considered free from it.

Second. — Keeping up the quarantine work, to prevent tuberculous animals from being introduced into the dairy and breeding herds of this Commonwealth from adjoining States. This includes the testing of all neat cattle brought into the State except beeves for immediate slaughter, or calves under six months old; cattle returning from out-of-State pastures, or coming in for exhibition purposes or returning home from cattle shows in adjoining States, are also exempt from the test. All the cattle upon which a test is required shipped to the stock yards at Brighton, Watertown and Somerville, are tested by the agent of the Cattle Bureau in charge of these quarantine stations. Cattle upon which a test is required brought to points outside of these stock yards, which are considered to be quarantine stations, must be accompanied by satisfactory certificates of tuberculin test made by veterinarians in the States from which they come, approved by the Chief of the Cattle Bureau; or they are held upon arrival at destination and tested by an agent of the Cattle Bureau, free of expense to citizens of Massachusetts and at cost to citizens of other States, but at their risk. Cattle passing a satisfactory test are released from quarantine.

Third. — The third division of the labor performed in connection with bovine tuberculosis is known as "voluntary request work," where entire herds are tested at the request of their owners, with a view to eradicating tuberculosis from them.

The following statement shows the number of cattle quarantined during the year by the local inspectors, or cattle from without the State held in quarantine awaiting a tuberculin test, or held after reacting to tuberculin, and the disposition made of them: —

Massachusetts Cattle.

Number released,	560	
Number condemned, killed and paid for,	1,302	
Number permit to kill, and paid for,	68	
Number permit to kill, no award,	116	
Number died in quarantine, no award,	78	
Number condemned and killed in process of settlement,	578	
Number released for lack of funds,	27	
Number in quarantine, unsettled,	1	
Total Massachusetts cattle quarantined,		2,730

Cattle from without the State.

Number released,	713	
Number condemned, killed and paid for,	4	
Number condemned and killed, no award,	167	
Number killed at owner's request after first test, no award,	5	
Number died in quarantine, no award,	3	
Number in quarantine, unsettled,	7	
Total, including 255 Brighton cattle held for retest,		899
Total number cattle quarantined,		3,629

Among the Massachusetts cattle quarantined, 59 were tested to satisfy the owners as to the presence or absence of disease; of these, 31 were condemned and killed and 28 were released.

Of the cattle quarantined as tuberculous, 2 were found affected with actinomycosis, and were released, to be killed for beef by owners.

Of the 176 condemned and killed on suspicion of being tuberculous, brought into Massachusetts from without the State, 103 were tested and retested at Brighton, and the other 73 were tested at other places. Four were found to show no lesions of tuberculosis, and the owners received pay therefor from the State. Of these 4, 2 were tested at Brighton and 2 at other points.

During the year 307 cattle, 12 calves and 28 swine were reported by butchers, renderers and boards of health as having been found tuberculous at time of slaughter. These animals were not quarantined, and are not included in the 3,629 above reported.

Two horses were also reported as having had tuberculosis; one received at rendering works in Marlborough, which was not proved by any laboratory examination; and one from Somerville, found by Dr. Rogers at the New England Rendering Works in Brighton, specimens from which were found to contain tubercle baccilli at the bacteriological laboratory of the Harvard Medical School. This disease in the equine species is very rare.

The *second section* of the work is given below, and includes the testing at Brighton and points outside, and also the granting of permits for bringing cattle from without the State to places outside the quarantine stations at Brighton, Watertown and Somerville.

Receipts of Stock at the Watertown Stock Yards, from Dec. 15, 1904, to Dec. 15, 1905.

Vermont cattle,	5,032
New Hampshire cattle,	5,519
New York cattle,	1,256
Massachusetts cattle,	2,642
Western cattle,	28,544
Sheep,	31,590
Swine,	4,394
Calves,	26,874

Receipts of Stock at the New England Dressed Meat and Wool Company's Yards at Somerville, from Dec. 15, 1904, to Dec. 15, 1905.

Maine cattle,	3,436
New Hampshire cattle,	1,898
Vermont cattle,	4,894
Massachusetts cattle,	1,128
Western cattle,	81,003
Sheep,	283,228
Swine,	1,223,578
Calves,	59,613

Cattle not for immediate slaughter have been tested by the agent of the Cattle Bureau at Brighton, and are included in the Brighton report.

Receipts of Stock at Brighton, from Dec. 15, 1904, to Dec. 15, 1905.

Maine cattle,	10,363
New Hampshire cattle,	1,917
New York cattle,	1,400
Vermont cattle,	1,392
Massachusetts cattle,	15,015
Western cattle,	68,412
Sheep,	49,378
Swine,	15,903
Calves,	47,240
Cattle tested,	13,833
Cattle released after test,	13,723
Cattle condemned after test,	95
Cattle killed at request of owners who preferred not to wait for second test,	15

As a rule, animals that react are held and retested a week later with a double dose of tuberculin, as animals that are feverish from other causes sometimes appear to give a reaction just after arrival at their destination.

Report of Cattle brought into the State during the Year, to Points outside of the Quarantine Stations.

During the year 1905 the following cattle were brought into the State to points outside of the quarantine stations: —

For dairy and breeding purposes, tested before shipment,	2,815
For dairy and breeding purposes, tested after arrival,	4,133
For dairy and breeding purposes, awaiting test,	4
	6,952
Neat cattle on which no test was required,	7,825
Total,	14,777

The cattle and calves on which no test was required were as follows: —

Returned from out-of-State pastures,		910
Calves under six months old,		384
Died before test could be made,		5
Condemned on physical examination without test, and killed,		1
Cattle for immediate slaughter,	2,388	
Calves for immediate slaughter,	4,137	
		6,525
Total,		7,825

Nearly all of these cattle were brought in on permits issued by the Chief of the Cattle Bureau, only 182 head having been brought in without permits, which were reported to this Bureau by railroad agents, local inspectors or others. Of these, 5 were accompanied by satisfactory certificates of tuberculin test, 5 were calves under six months old, 2 were slaughtered at once for beef, 2 were returned from pasture, 1 was condemned on physical examination and killed, and the remainder, 167 head, were tested by agents of the Cattle Bureau. There were also 6 herds brought into the State for exhibition purposes, unaccompanied by permits, but these were reported and looked after by the local inspector at the place where they were exhibited.

There were 838 permits issued, 108 of which were not used; on the balance, 14,595 head of cattle were brought into the State.

Eleven permits were issued allowing cattle to be brought into the State for exhibition at agricultural fairs, to remain for a short time only, and 3 for bringing cattle back from exhibition at fairs in other States. Four permits were given for pasturing cattle in this State for a short period or for the season, 1 permit was given for returning cattle daily from a pasture in Connecticut, 1 allowing an ox team to be used in this State going back and forth across the border line, 1 for cattle to be unloaded *en route* through the State, 1 allowing a large bull to be exhibited at a museum during the season, and 1 allowing an owner who lived near the New Hampshire line to bring Massachusetts cattle back into the State after being loaded at a station in New Hampshire simply as a matter of convenience.

Some opposition has developed during the past spring to the provisions of Cattle Bureau Order, No. 11, requiring a tuberculin test upon all cattle brought into Massachusetts to be kept here, except calves under six months old and beeves for immediate slaughter; and last April a number of members of the Massachusetts Cattle Owners' Association petitioned the Governor, the Executive Council and the Chief of the Cattle Bureau to amend that part of the rules and regulations which provides that all cattle except those for immediate slaughter, or calves under six months old, must

be tested with tuberculin by a person approved by the Chief of the Cattle Bureau, either prior to shipment or after arrival at destination, unless permission to omit the test is given by the Chief of the Bureau, for some good reason.

This petition was referred to the Chief of the Cattle Bureau April 21, with the request by the Governor and Council that he give the petitioners a hearing. A hearing was accordingly granted the members of the Massachusetts Cattle Owners' Association in the room of the State Board of Agriculture, No. 136 State House, on May 4, 1905. After considering arguments for and against changing the rules and regulations of the Cattle Bureau of the State Board of Agriculture contained in Cattle Bureau Order, No. 11, the Chief of the Cattle Bureau reported to the Governor and Council that it seemed to him that it would be unwise to make any change in the present rules and regulations of the Cattle Bureau relating to the introduction of neat cattle from other States into the Commonwealth of Massachusetts. He also gave it as his opinion that the request of the petitioners for revoking the portion of Cattle Bureau Order, No. 11, requiring a tuberculin test should not be granted.

The petitioners appealed from the decision of the Chief of the Cattle Bureau to the Governor and Council, but as yet no further action has been taken in the matter.

If the Commonwealth is to continue the policy of paying owners of tuberculous animals for cattle that are killed by the State authority, it seems only proper to require that cattle brought in from surrounding States should be free from tuberculosis, and the best method of determining accurately whether they are free from this disease or not is by means of the tuberculin test; therefore, it is to be hoped that no change will be made in the rules.

The third portion of this work, or "voluntary request work," has been very limited during the past year, as shown in the appended list: —

Number of herds tested,		9
Number of animals tested,		180
Number condemned and rendered,	50	
Number condemned and passed for beef, no award,	40	
Number that did not react,	90	
		180

This is about half as much as was done the previous year, with a much larger percentage of reacting animals.

One reason why so few herds are tested is that the State does not pay for all reacting animals, but only for those that are rendered, the owner receiving what the butcher will allow for the slightly diseased. This places so much of the burden of expense upon the owner that there is not a great demand for herd tests based upon such onerous conditions.

There are undoubtedly a large number of owners of herds in Massachusetts who have their cattle tested at their own expense, and who keep their herds clean free of cost to the State; and there are also a number of farmers whose herds have been cleaned up in previous years from whom no recent complaint has been received, and where disease has not reappeared. There are, however, not any available figures to be quoted in this connection.

A practical method of immunization of cattle to be introduced into herds where tuberculosis exists or has existed is also greatly to be desired. Koch, Von Behring and others have done work in this line, and Von Behring claims to have discovered a satisfactory method. So far it has only been applied to calves to be raised in herds where tuberculosis exists. Young calves receive an intravenous injection of a certain quantity of an attenuated human tubercle culture, and in three months a second dose five times the size of the first is given in the same way. It is claimed that calves thus treated are immunized for a considerable period, — two or three years; whether this immunity lasts for the natural length of the animal's life it is yet too soon to say. This method may in time prove of great value to farmers, especially to breeders of pure-bred stock owning herds in which tuberculosis exists.

If a similar method can be applied to older cattle about to be introduced into dairy herds where tuberculosis is present, it may prove of great benefit. New purchases, after being tested with tuberculin and found to be free from tuberculosis, can be placed in a quarantine stable and immunized before being introduced into the herd. Such a plan, if it proves practicable, would be of great assistance towards the eradication of this disease from herds which depend upon the

purchase of new milch cows to replenish the stock, rather than raising young animals for this purpose.

Experiments might well be undertaken by the Cattle Bureau, with an expert consultant like Dr. Theobald Smith to direct them, at the Agricultural College Experiment Station or some suitable place, if funds for this purpose could be provided, with a view to studying the efficacy of Von Behring's and other methods, and, if a satisfactory result was obtained, the benefits could be placed at the disposal of our farmers.

If work were undertaken in this direction certain questions could be solved in a few months, while other experiments would require a period of two or three years.

Glanders.

It is ground for encouragement to be able to state that there has been a continued diminution in the number of cases of glanders in Massachusetts during the year ending Dec. 15, 1905, from the previous year.

As far as it is possible to ascertain (and the means of the Cattle Bureau for obtaining reports are fairly complete), 624 horses have been killed or have died with glanders or farcy in Massachusetts during the year ending Dec. 15, 1905. This is 185 less than in 1904 and 236 fewer than in 1903, — in fact, less than during any year since 1899, when the number of positive cases was 543. At that time, however, the means of obtaining full and complete reports were not as reliable as at present.

The total number of horses or mules reported as having glanders, or dealt with, has been 899. Of these, 275 have been negative; some have been reported as suspected of having glanders or farcy by the local inspectors of animals or others, and upon examination have been found to be free from contagious disease; the remainder are animals that were in stables where the mallein test was applied, and after one or more tests were released as free from infection.

The decrease in the number of cases of glanders during the past two years must be largely ascribed to the patient and unremitting toil of the agents of the Cattle Bureau. Another important factor is believed to be due to sending

an agent to the stables where cases occur outside the limits of Boston, within ten or twelve miles of the State House, to disinfect the stalls occupied by animals that were diseased. This agent has also disinfected the blacksmith shops where diseased animals have recently been shod, and has also incidentally kept up an inspection of the public watering troughs in surrounding cities and towns. Where a trough has been found to be dirty, it has been reported to the Chief of the Cattle Bureau, who has immediately written to the superintendent of the water works in the city or town where the trough was situated, requesting that it be immediately cleansed, and in future, if possible, kept clean.

The practice of having stables disinfected in Worcester and Fall River, in cases where the owner was not competent or in a position to do it, has also been continued, with beneficial results.

The use of mallein in eradicating glanders from infected stables has also no doubt contributed its share to the diminution of the disease.

The results of all this work are shown in the following table: —

CITY OR TOWN.	1904.		1905.		Increase.	Decrease.
	Killed or died.	Negative.	Killed or died.	Negative.		
Acton,	4	1	–	–	–	4
Adams,	4	1	1	1	–	3
Amesbury,	1	–	1	–	–	–
Amherst,	–	–	3	–	3	–
Andover,	–	–	2	2	2	–
Arlington,	7	3	13	9	6	–
Ashby,	–	–	2	1	2	–
Ashland,	1	–	–	–	–	1
Athol,	2	1	–	–	–	2

CITY OR TOWN.	1904.		1905.		Increase.	Decrease.
	Killed or died.	Negative.	Killed or died.	Negative.		
Attleborough,	–	–	1	–	1	–
Auburn,	1	–	2	1	1	–
Avon,	1	–	–	–	–	1
Barnstable,	–	2	–	2	–	–
Barre,	–	–	1	–	1	–
Belchertown,	1	1	–	–	–	1
Bellingham,	–	–	2	1	2	–
Belmont,	2	–	4	–	2	–
Bernardston,	–	–	–	1	–	–
Beverly,	3	–	3	7	–	–
Billerica,	–	1	–	1	–	–
Blackstone,	–	–	1	1	1	–
Boston,	254	23	210	20	–	44
Boxford,	–	–	–	1	–	–
Boylston,	–	2	4	–	4	–
Braintree,	3	1	1	1	–	2
Bridgewater,	–	–	1	4	1	–
Brockton,	4	6	1	1	–	3
Brookline,	3	1	10	5	7	–
Cambridge,	86	12	55	12	–	31
Canton,	–	–	–	1	–	–
Charlton,	3	–	2	–	–	1
Chelmsford,	–	3	2	–	2	–
Chelsea,	16	4	14	–	–	2
Clinton,	2	1	1	–	–	1

CITY OR TOWN.	1904.		1905.		Increase.	Decrease.
	Killed or died.	Negative.	Killed or died.	Negative.		
Colrain, . . .	–	1	–	1	–	–
Concord, . .	6	1	–	–	–	6
Danvers, . .	4	1	1	–	–	3
Dartmouth, . .	1	1	1	1	–	–
Dedham, . .	7	1	4	1	–	3
Douglas, . .	–	–	–	1	–	–
Dover, . . .	–	–	2	9	2	–
Dracut, . . .	1	1	–	–	–	1
Easton, . . .	–	–	2	–	2	–
Essex, . . .	2	–	–	–	–	2
Everett, . . .	6	2	8	2	2	–
Fairhaven, . .	–	–	1	–	1	–
Fall River, . .	37	7	14	37	–	23
Fitchburg, . .	1	1	–	2	–	1
Foxborough, . .	1	1	–	–	–	1
Framingham, . .	2	1	1	1	–	1
Franklin, . .	–	1	2	–	2	–
Freetown, . .	1	–	–	–	–	1
Gardner, . . .	1	1	5	17	4	–
Gloucester, . .	1	1	–	1	–	1
Grafton, . . .	2	–	1	2	–	1
Greenfield, . .	3	–	–	2	–	3
Groton, . . .	–	–	–	1	–	–
Halifax, . . .	–	–	–	1	–	–
Hardwick, . .	–	–	–	2	–	–

CITY OR TOWN.	1904.		1905.		Increase.	Decrease.
	Killed or died.	Negative.	Killed or died.	Negative.		
Harvard,	1	–	–	–	–	1
Harwich,	–	–	1	–	1	–
Haverhill,	3	–	–	4	–	3
Hingham,	–	1	3	1	3	–
Holden,	1	–	3	–	2	–
Holliston,	1	–	4	–	3	–
Hubbardston,	–	1	1	–	1	–
Hudson,	–	–	1	1	1	–
Hyde Park,	3	–	1	1	–	2
Ipswich,	–	1	–	1	–	–
Kingston,	3	–	1	–	–	2
Lancaster,	–	–	–	2	–	–
Lawrence,	14	15	4	5	–	10
Leominster,	–	2	1	1	1	–
Lexington,	8	1	2	10	–	6
Lincoln,	5	4	–	1	–	5
Lowell,	23	2	9	3	–	14
Lynn,	10	2	6	4	–	4
Malden,	6	3	2	2	–	4
Mansfield,	–	–	–	1	–	–
Marblehead,	1	1	–	–	–	1
Marlborough,	1	–	4	1	3	–
Marshfield,	1	–	–	–	–	1
Maynard,	1	1	–	–	–	1
Medfield,	2	–	–	–	–	2

CITY OR TOWN.	1904.		1905.		Increase.	Decrease.
	Killed or died.	Negative.	Killed or died.	Negative.		
Medford,	3	–	3	2	–	–
Medway,	1	–	–	–	–	1
Melrose,	1	1	2	–	1	–
Mendon,	–	–	1	–	1	–
Methuen,	3	–	–	1	–	3
Milford,	–	–	1	–	1	–
Milton,	3	–	4	1	1	–
Montague,	–	–	–	1	–	–
Nahant,	2	–	1	–	–	1
Natick,	3	1	2	–	–	1
Needham,	4	–	–	–	–	4
New Bedford,	1	2	10	–	9	–
Newbury,	1	–	–	–	–	1
Newburyport,	3	–	1	1	–	2
Newton,	8	6	6	2	–	2
North Adams,	1	1	1	–	–	–
North Andover,	4	–	1	5	–	3
North Attleborough,	–	1	1	2	1	–
Northampton,	1	1	–	–	–	1
Northbridge,	–	1	–	1	–	–
Northborough,	1	–	4	–	3	–
Northfield,	–	2	–	2	–	–
Norwood,	1	–	–	–	–	1
Orange,	–	3	–	2	–	–
Oxford,	1	–	5	–	4	–

CITY OR TOWN.	1904. Killed or died.	1904. Negative.	1905. Killed or died.	1905. Negative.	Increase.	Decrease.
Paxton,	1	1	–	–	–	1
Peabody,	–	–	–	2	–	–
Pepperell,	5	–	–	1	–	5
Pittsfield,	1	1	–	–	–	1
Plymouth,	–	–	–	1	–	–
Princeton,	2	2	2	10	–	–
Quincy,	5	1	2	1	–	3
Randolph,	5	4	1	1	–	4
Revere,	2	2	1	–	–	1
Rochester,	–	–	–	1	–	–
Royalston,	–	–	–	1	–	–
Rutland,	1	–	–	–	–	1
Salem,	4	1	2	1	–	2
Saugus,	–	4	1	4	1	–
Scituate,	1	–	–	–	–	1
Seekonk,	–	–	2	–	2	–
Sharon,	1	1	–	–	–	1
Sherborn,	1	–	–	–	–	1
Shirley,	–	–	2	–	2	–
Somerville,	61	11	28	5	–	33
Southbridge,	1	–	1	–	–	–
Southwick,	–	–	–	1	–	–
Shrewsbury,	–	–	2	1	2	–
Spencer,	1	–	–	–	–	1
Springfield,	–	1	2	–	2	–

CITY OR TOWN.	1904.		1905.		Increase.	Decrease.
	Killed or died.	Negative.	Killed or died.	Negative.		
Sterling,	–	–	1	–	1	–
Stoneham,	1	–	–	–	–	1
Stoughton,	–	1	3	–	3	–
Stow,	1	1	1	1	–	–
Sudbury,	1	4	3	3	2	–
Sutton,	–	2	1	–	1	–
Swampscott,	–	–	2	–	2	–
Swansea,	1	–	–	–	–	1
Taunton,	3	–	–	–	–	3
Topsfield,	–	1	2	–	2	–
Uxbridge,	1	–	2	1	1	–
Wakefield,	4	–	6	3	2	–
Walpole,	1	1	1	–	–	–
Waltham,	1	1	2	2	1	–
Ware,	–	–	–	1	–	–
Watertown,	7	3	7	7	–	–
Wayland,	2	–	1	1	–	1
Wellesley,	–	–	–	1	–	–
Wellfleet,	–	–	–	3	–	–
Wendell,	–	–	1	–	1	–
West Boylston,	–	–	–	1	–	–
Westford,	2	–	–	–	–	2
Westminster,	4	2	2	1	–	2
Weston,	2	–	–	–	–	2
Westport,	–	–	3	–	3	–

CITY OR TOWN.	1904.		1905.		Increase.	Decrease.
	Killed or died.	Negative.	Killed or died.	Negative.		
Westwood, . .	4	1	10	4	6	–
Weymouth, . .	1	4	2	–	1	–
Winchester, . .	2	2	2	–	–	–
Winthrop, . .	1	–	–	–	–	1
Woburn, . .	1	1	1	1	–	–
Worcester, . .	77	3	60	4	–	17
Totals, . .	809	217 [1]	624	275	–	–

[1] Towns with negative cases only in 1904 are not tabulated unless there were positive or negative cases in them during 1905.

The close of 1905 leaves all cases of glanders or farcy reported during the year disposed of, — a much more satisfactory condition than usual.

In the sixth semiannual report of the Chief of the Cattle Bureau, January, 1905, 10 suspected cases remained to be decided later, in connection with unfinished stable tests; of these, 8 horses ceased to react and were released from quarantine, and 2 developed physical evidence of disease and were killed, 1 in Cambridge and the other in Clinton, making the actual number killed during the year 626; but the 2 mentioned are tabulated among the undecided cases of 1904, leaving 624 new cases which have been destroyed or died. Only one error in diagnosis has been made among the horses killed. This animal was found on autopsy to be free from glanders, and the Commonwealth paid $125 for it.

It will be seen by the above table that in Boston there is a falling off of 44 cases from the previous year, as reported by the veterinarian of the Boston board of health, which has entire charge of glanders in the city of Boston, and that outside of Boston the decrease is 142. That is, outside of the limits of the city of Boston there has been a decrease of about 25 per cent, and in Boston it has de-

creased 17 per cent. About two-thirds of the cases in Massachusetts occur outside of Boston; the other one-third occur in the city. One-half of all the cases occurred in the cities of Boston, Cambridge, Somerville, Chelsea and Everett. About 380 of the actual cases occurred within ten miles of the State House.

The two cities outside of the metropolitan district which seem to be separate centres of importance are Worcester and Fall River. It will be seen that the former shows a decrease of 22 per cent and the latter of over 62 per cent. The only good-sized city to show much of an increase is New Bedford, and even there the number of cases did not exceed those in Arlington, Brookline or Westwood. Lawrence shows a falling off of 71 per cent, Lowell of 60 per cent, Cambridge of 36 per cent and Somerville of 54 per cent. The number of cases reported as positive in Boston are those given by courtesy of the veterinarian of the Boston board of health. Most of the negative ones were reported by the renderers, which upon investigation the veterinarian of the Boston board of health decided were not suffering from glanders.

Cases of glanders or farcy occurred in 98 cities and towns in 1905, as compared with 105 in 1904; it occurred both years in 64 cities and towns; no cases occurred in 41 places in 1905 where it was found in 1904, and it appeared in 34 towns where it did not occur in 1904; but in most instances where the disease appears in a town one year and disappears the following season the cases are isolated ones, the origin of which, as a rule, can be traced to another locality.

Less work has been done with mallein in making stable tests in 1905 than in the preceding year, but where it has been used the results seem to have been of assistance in cleaning up centres of infection.

The following table shows the amount of work done in testing horses in stables where glanders has occurred, and the results: —

Stable Tests with Mallein.

Cities and Towns.	Number of Stables.	Number of Horses tested.	Released on First Test.	Released on Subsequent Test.	Killed, with Clinical Evidence of Glanders.
Arlington,[1]	1	10	–	10	–
Beverly, ...	1	6	–	6	–
Brookline, ...	1	5	2	2	1
Cambridge, ...	1	2	2	–	–
Dover,[2]	1	10	9	1	–
Fall River, ...	1	35	26	9	–
Gardner, ...	1	16	14	2	–
Lexington, ...	1	9	7	2	–
North Andover, . . .	1	5	5	–	–
Princeton, ...	1	9	9	–	–
Westwood, ...	1	6	1	3	2
Totals, ...	11	113	75	35	3

[1] Two cases died after release, and showed lesions of glanders on post-mortem examination.

[2] One negative case developed glanders, and was killed two months later.

It is believed that glanders could be more rapidly diminished in this Commonwealth if measures similar to those followed by the Canadian government could be adopted. In Canada, when glanders appears in a stable, all animals showing physical evidence of disease are killed; all contact animals are tested with mallein; and all that react but show no physical signs of disease are killed and the owner is paid two-thirds of an animal's value, or if the owner prefers, he can keep the animals, but they are to be retested from time to time, and any that react to the third test are killed, and the owner is paid two-thirds of each animal's value, if it does not develop physical evidence of disease up to the time it is destroyed. If the Massachusetts law could be amended

so as to permit of a similar method, it would be an advance in the direction of still further diminishing this disease, until in a few years it would be practically extirpated. At the present time it is altogether too prevalent, when the danger it involves, not only to our property but to human life, is considered.

Cattle Bureau Order, No. 12, was faulty, in that it did not give the Chief of the Cattle Bureau sufficient authority in stables where glanders exists. It was therefore rewritten and issued as a new order, as follows: —

CATTLE BUREAU ORDER, NO. 13.

COMMONWEALTH OF MASSACHUSETTS,
CATTLE BUREAU OF THE STATE BOARD OF AGRICULTURE,
STATE HOUSE, BOSTON, June 28, 1905.

To All Persons whom it may concern.

Cattle Bureau Order, No. 12, is hereby amended so as to read as follows: —

By virtue of the power and authority vested by law in the Cattle Bureau of the State Board of Agriculture, under the provisions of chapter 90 of the Revised Laws and chapter 116 of the Acts of 1902, you are hereby notified that glanders or farcy, which is a contagious disease, and is so recognized under the laws of this Commonwealth, prevails extensively among horses and mules in some sections of this State.

You are hereby further notified that, in order to prevent its spread, this Bureau has issued the following order: —

1. In stables or upon premises where horses or mules are kept in this Commonwealth (except Boston) in which cases of glanders or farcy occur, any or all of the animals kept in such stables or upon such premises will be tested with mallein in such instances as the Chief of the Cattle Bureau deems it necessary to do so. Animals reacting to the mallein test will be held in quarantine, and the owners are forbidden to sell or dispose of such animals until they are released from quarantine by order of the Chief of the Cattle Bureau; but he will give permission to use animals which do not show physical symptoms of glanders or farcy. Animals which develop physical signs of glanders or farcy will be killed; animals ceasing to react will be released as soon as the public safety will permit.

2. When an animal with glanders or farcy has died, or is killed by order of the Chief of the Cattle Bureau or with the

consent of the owner (outside of the City of Boston), no other horse or mule shall be put in any stall, shed or inclosure formerly occupied by an animal so diseased, until such stall, shed or inclosure has been thoroughly disinfected in accordance with the rules and regulations of the Cattle Bureau.

3. In stables where any or all of the animals are tested with mallein by order of the Chief of the Cattle Bureau, or where he notifies the owner or owners of animals occupying the premises that such premises are infected with glanders, no horses or mules shall be introduced into, sold or removed from such stable without his sanction, until he declares the premises free from infection.

4. Blacksmiths, when directed to do so, must disinfect their shops in accordance with the instructions of the Chief of the Cattle Bureau or his authorized agent.

5. In instances where the circumstances require it, the proper authorities are hereby ordered to close the public watering troughs when directed to do so by the Chief of the Cattle Bureau, the same to remain closed until he gives permission to reopen them. Public watering troughs in cities or towns (outside of Boston) where cases of glanders occur are to be cleansed at least once a week during the summer months.

Inspectors of animals in towns where glanders or farcy occurs shall publish this order forthwith by posting a printed copy thereof in three or more public places within the limits of their respective cities or towns.

This order shall take effect upon its approval.

AUSTIN PETERS,
Chief of Cattle Bureau.

COUNCIL CHAMBER, STATE HOUSE,

Approved in Council, July 5, 1905.
EDWARD F. HAMLIN,
Executive Secretary.

Copies of this order have been sent to the inspectors of animals in cities and towns where glanders has occurred, to post in public places; and copies with section 5 underscored have also been sent to the superintendents of water works in the cities and towns where glanders has been especially prevalent.

The reports of renderers, as required by section 111 of chapter 75 of the Revised Laws, continue to be of value, as by them a number of cases are heard of which are not other-

wise reported. In such instances the inspector of animals or an agent of the Cattle Bureau is directed to see that the premises are properly disinfected, and to inspect the other horses or mules when any are kept in such stables, to be sure that there are no others showing evidence of the disease.

The following table shows that 59 cases were reported by the renderers outside the limits of the city of Boston, of which the Chief of the Cattle Bureau had no previous notification: —

Reports of Rendering Companies, 1905.

Rendering Companies.	Number of Reports.	Number of Cases.	Number in Boston.	Number out of Boston.	Number outside of Boston not previously reported.
Guy U. Barnes Rendering Company, Fall River.	26	15	–	15	–
John J. Burke, South Sherborn.	8	6	–	6	1
C. S. Bard, Haverhill, . .	1	1	–	1	–
Lowell Rendering Company,	14	–	–	–	–
W. C. Lawrence, Whitman, .	1	1	–	1	–
Muller Bros., North Cambridge.	36	72	7	65	8
Jas. E. McGovern, Lawrence,	7	6	–	6	–
New Bedford Extractor Company.	3	3	–	3	–
W. H. Nankervis, Marlborough.	15	12	–	12	3
New England Rendering Company, Brighton.	44	84	18	66	21
Parmenter & Polsey Fertilizer Company, Peabody.	21	12	–	12	2
Roy & Sons, South Attleborough.	3	3	–	3	–
Springfield Rendering Company.	1	–	–	–	–
Worcester Rendering Company, Auburn.	27	59	–	59	17
Whitman & Pratt Rendering Company, North Chelmsford.	20	4	–	4	1
N. Ward Company, Boston, .	47	183	154	29	6
Totals, ...	274	461	179	282	59

NOTE. — Where the total number of a renderer's reports exceeds the number of cases of glanders or farcy reported, it is because some of the reports have been of tuberculosis among cattle received at these establishments.

In doubtful cases the guinea-pig test still proves of great value as an aid in determining the presence or absence of glanders or farcy. The laboratory work has been performed by Dr. Langdon Frothingham at the Harvard Medical School, as it has been for several years past.

Most of the field work has been performed by Dr. Howard P. Rogers, assisted, when necessary, by Dr. Wm. T. White.

Cases of human glanders have again occurred during the past year, one fatal case occurring in Sutton, where a man contracted the disease from his horse. Another case was that of a young man in Oxford, who was at the Worcester City Hospital for a while, and at last accounts was said to be convalescent. Several cases of glanders occurred among the horses on the farm of this young man's father, and he undoubtedly became infected from them.

Several prosecutions have been undertaken during the past year, most of which have resulted in convictions.

In Worcester a man was prosecuted for neglecting to report a case of glanders in his stable, when he undoubtedly knew the horse was diseased. He was convicted, and fined fifty dollars.

In Fitchburg three horse traders were proceeded against for trading about a pair of glandered horses. The court held that, while the Commonwealth did not prove that these men knew the horses had glanders or farcy, it did show that they had reasonable grounds to believe that the animals were suffering from some disorder, and that they should have consulted expert opinion before disposing of them; and it therefore decided that they were criminally negligent, and imposed a fine of thirty dollars upon each. The defendants appealed. Whether the case will be carried to a higher court or not is not yet known.

A Watertown man was summoned into court at Waltham upon a complaint accusing him of not reporting a case of glanders in his stable, knowing or having reasonable cause to believe that the animal was suffering from a contagious disease. In this case the defendant was found not guilty, and discharged.

Whether farmers and others in the country have profited by the advice in the sixth semiannual report to beware of

cheap horse dealers in the cities or not is unknown; but the fact remains that there have been practically no complaints this year of owners in country towns having horses destroyed that had been recently purchased in the city, and found to be diseased with glanders or farcy after arrival at the homes of the purchasers.

It may be that the work accomplished by the veterinarian of the Boston board of health and the agents of the Cattle Bureau in diminishing the prevalence of the disease has led to fewer animals showing clinical evidence of this malady finding their way into the hands of this class of dealers.

Rabies.

At the time of making the sixth semiannual report to the State Board of Agriculture, it was stated that rabies had become so infrequent that it might be said that it was practically unknown in this Commonwealth.

For more than a year, from September, 1903, to November, 1904, there was not a single authentic case of rabies reported to the Cattle Bureau in Massachusetts. At the time of making the report in January, 1905, two recent cases had been reported, one being a dog owned in Somerville, reported in November, 1904, and the other a dog in Milton, reported in December, 1904. Since that time a number of serious outbreaks have been reported, and the disease has been very troublesome and annoying in several localities for a number of months, causing a great deal of worry and loss to dog owners, some loss of human life, and anxiety and expense to a number of people who went to New York to receive the Pasteur anti-rabic treatment from the New York City board of health, as well as some loss of property to owners of cattle and poultry. At the time of making the seventh semiannual report, last July, a brief account was given of a serious outbreak in Lowell. Since then the disease has prevailed extensively in parts of Worcester and Middlesex counties.

In Worcester County numerous cases have occurred since July, in Northbridge, Grafton, Westborough, Northborough, Uxbridge, Upton, Milford, Hopkinton, Clinton and Lancaster, with a few isolated cases in Worcester, Leominster and Holden.

In Middlesex County, in addition to outbreaks in Lowell and Dracut, the disease has occurred in Marlborough to a considerable extent, with a few cases in Framingham, Natick, Weston, Waltham, Arlington, Lexington and Medford.

In Norfolk County, in addition to the case in Milton, there have been cases in Weymouth and Mansfield.

The outbreaks in Marlborough, Hopkinton and Weymouth are recent and the trouble cannot be considered as over in any of these towns. Two or three recent cases in Worcester may make it necessary for the mayor and aldermen to adopt an order requiring all dogs in that city to be properly and securely muzzled for a while. There has also been a second outbreak recently in Dracut and Lowell, but here the situation seems to be well in hand. In Essex county there has been a couple of cases this past autumn at Topsfield, but it is hoped that the disease there is under control, and that there will be no further trouble in that locality.

The following table shows to what extent rabies has prevailed among dogs, and the localities in which it has occurred, and also gives somewhat of an idea of the work it has entailed upon the agents of the Cattle Bureau and the local inspectors of animals: —

Table showing Cases of Rabies in Dogs, to Jan. 1, 1906.

City or Town.	Original Dogs.	Became Rabid in Quarantine. Killed or died.	Killed in Quarantine with Owner's Consent. Not Rabid.	Released from Quarantine at End of Ninety Days.	Still held in Quarantine.	Remarks.
Adams,	1	-	-	-	-	Came from Springfield; pup; isolated case.
Arlington,	1	-	-	-	-	- - - -
Boxford,	1	1	-	-	7	Kennel of bird dogs; original case brought from Virginia.
Clinton,	1	-	1	2	-	Original dog came from Lancaster.
Dracut,	2	-	7	-	7	One of original dogs came from Lowell.
Douglas,	-	1	-	12	-	Original dog same as appeared in Whitinsville July 29 and 30.
Egremont,	-	-	1	-	-	- - - -
Framingham,	-	-	1	-	-	Original dog owned in Framingham; killed in Holden.
Grafton,	2	2	-	6	-	Original dog unknown; stray No. 107. Other owned in Grafton; ran to Kingston and died.
Holden,	1	-	-	-	-	Dog owned in South Framingham; bit people in Marlborough and Holden and dogs in Marlborough.

Table showing Cases of Rabies in Dogs, etc. — Concluded.

City or Town.	Original Dogs.	Became Rabid in Quarantine. Killed or died.	Killed in Quarantine with Owner's Consent. Not Rabid.	Released from Quarantine at End of Ninety Days.	Still held in Quarantine.	Remarks.
Hopkinton, . .	1	1	8	–	3	Original dog owned in Hopkinton; bit owner.
Lancaster, . .	–	–	–	6	–	Original dog killed in Clinton, after biting children and dogs.
Leominster, . .	1	–	–	–	–	Came from Clinton; bit only people.
Lexington, . .	1	4	–	–	–	Original dog stray hound.
Lowell, . . .	15	–	5	6	–	Cannot say which of mad dogs were original cases.
Malden, . . .	1	–	–	–	–	– – – –
Mansfield, . .	1	–	2	2	–	Original a stray dog; appeared in town October 3.
Marlborough, . .	2	1	1	–	4	A fifth dog in quarantine ran away after sixty-two or sixty-three days.
Maynard, . . .	1	–	–	1	–	– – – –
Medford, . . .	2	–	–	–	–	– – – –
Milford, . . .	6	–	1	1	2	– – – –
Millis, . . .	1	–	–	–	–	Came from Milford; not known to have bitten dogs in Millis.
Milton, . . .	1	–	1	–	–	– – – –
Mount Washington,	1	1	2	–	4	Stray dog may have come from Connecticut; also bit a man.
Natick, . . .	1	–	–	–	–	Stray dog, supposed to have been rabid.
Newton, . . .	1	–	–	–	–	Dog from Pennsylvania; bit dog in Weston; may be cause of outbreak in Middlesex and Worcester counties.
Northborough, .	–	–	–	3	–	Original dog from Westborough.
Northbridge, . .	3	12	12	32	–	Stray dog in Whitinsville July 29 and 30, — very busy dog; also stray from Milford, and one unknown.
Quincy, . . .	1	–	–	–	–	Killed by inspector; suspected.
Topsfield, . . .	–	–	–	–	1	In contact with Boxford dogs.
Tyngsborough, .	–	–	–	3	–	In contact with dog from Lowell.
Upton, . . .	1	5	1	13	2	Original dog stray unknown, No. 107, that was original in Grafton; one stray caused second outbreak.
Uxbridge, . .	–	3	–	–	–	Original was No. 107.
Waltham, . . .	1	2	–	4	–	Stray dog; bit dogs in kennel.
Watertown, . .	1	–	–	–	–	– – – –
Westborough, . .	2	6	10	2	–	One of originals bit several people; wounds were cauterized.
Weston, . . .	–	1	–	2	–	Original was dog from Pennsylvania.
Weymouth, . .	1	1	–	–	1	Original was unknown stray.
Worcester, . .	2	–	–	–	–	– – – –
Totals, . .	57	41	53	95	31	
	41					
Total rabid, .	98					

It will be seen by the above table that 57 cases of rabies have been reported through various sources as original cases; in addition, 41 dogs have become rabid after being quarantined on suspicion of having been bitten by mad dogs, making 98 actual cases among dogs; besides these, there must undoubtedly have been a number of canines which developed the disease and died or were killed, of which no report was received at the Cattle Bureau office. Fifty-three dogs have been killed with the owners' consent, who preferred to have them destroyed rather than run any risk, or have the trouble of keeping them in quarantine for ninety days.

Ninety-five dogs have been kept in quarantine for ninety days and released at the end of that period as free from infection, among which should be included one dog which ran away from home after being in quarantine about sixty-four days. The latter animal the owner reports did not act peculiarly, and probably ran away in disgust at being kept shut up so long. Thirty-one dogs are still held in quarantine, making 278 dogs in all that have been dealt with.

In addition to the dogs, there have been 5 cases among cattle, — 2 in Upton, 2 in Grafton and 1 in Marlborough. A cow and calf supposed to have been bitten have been released in Westborough at the expiration of ninety days, and there still remains in quarantine a cow in Marlborough. A pig died of rabies in Grafton, as the result of the bite of a mad dog; and another pig was killed in Dracut because it was bitten, and the owner did not care to take any chances with it.

Two horses are in quarantine in Weymouth because of being recently bitten on their noses by a rabid dog, which had taken it into his head to guard a public watering trough, and snapped at every horse that approached it to drink; making a total of nearly 300 cases which have been dealt with, not to mention numerous hens and ducks that have been killed by mad dogs.

A number of people have also been bitten, — in Clinton, Marlborough, Holden, Westborough, Upton, Hopkinton, Grafton, Mount Washington, Leominster and Lowell. Some

of these have had to go to the expense of visiting New York City to receive the Pasteur anti-rabic treatment, and 2 died after completing the treatment and returning home. These fatalities occurred in Lowell, the victims being a father and his married daughter. They were bitten very badly on their faces and hands by a pet dog April 13, went to New York for the preventive treatment given by the New York City board of health, and returned home. The woman died May 12 and the man July 3.

In dealing with rabies, it has been the endeavor to work as much as possible through the local authorities. Inspectors of animals have been directed to quarantine all dogs and other animals that were known to have been bitten or suspected of having been bitten by rabid dogs; and this quarantine has been enforced for ninety days, unless the animals became rabid and were killed, or the owners desired to kill them to avoid the trouble of keeping them in quarantine, in which instances owners have had permission to destroy them in the presence of the inspector of animals or an agent of the Cattle Bureau.

Mayors and aldermen in cities and selectmen in towns have been advised to issue muzzling orders in places where the disease has prevailed extensively, requiring that all dogs running at large shall be properly and securely muzzled, under the authority given them in section 158 of chapter 102 of the Revised Laws, and the police authorities have been requested to enforce the dog license law, and destroy all homeless and ownerless canines. The Lowell police are said to have killed from 200 to 300 dogs of this description at the time of the outbreak of rabies in that city last spring. Agents of the Cattle Bureau have been sent to the towns where the outbreaks occurred, to see that the quarantine regulations were enforced and to advise with the local authorities upon the best course to pursue. In many of the towns where the most serious outbreaks have occurred muzzling orders have been issued by the local authorities, to continue in force for periods varying from thirty to sixty days.

When rabies appears in a city or town, from twelve to

twenty copies of the following notice are sent to the local inspector, to be posted in public places in various parts of the town, the inspector's name being printed upon the lower left-hand corner: —

COMMONWEALTH OF MASSACHUSETTS,
CATTLE BUREAU OF THE STATE BOARD OF AGRICULTURE.

NOTICE.

A number of cases of rabies have occurred recently among dogs in several towns in the State, and it seems quite probable that cases may occur in this town. It is the duty of every one, therefore, to co-operate with the State and local authorities in doing everything possible toward the suppression of this disease.

In towns where rabies exists, the selectmen have the necessary authority to order all dogs running at large to be muzzled, under section 158 of chapter 102 of the Revised Laws. A muzzling order should require dogs to be properly and efficiently muzzled for at least sixty days, — ninety days would be better.

All persons are cautioned against the danger of attempting to pet or fondle strange dogs.

Any person noticing a dog acting in a peculiar or unusual manner should at once notify the local inspector of animals.

If a dog should bite any one, it is unwise to immediately destroy it, if it can be secured without its doing further harm, as a dog suspected of having rabies should be securely chained or shut up in a box stall for a few days, where it can be observed. Tying with a rope is unsafe, as the dog might gnaw the rope in two and escape. If the dog remains well, it is certain that it is not rabid, and the person bitten need have no cause for alarm. If the dog should die, or is killed on suspicion of having rabies, the head should be sent to the Chief of the Cattle Bureau of the State Board of Agriculture, who will have it examined in order to ascertain whether it had rabies or not. If there should be good grounds for suspecting that a dog so examined had rabies, and it had bitten any one, a report will be made to the person bitten, or the attending physician, in order that the injured person can go to New York for the anti-rabic treatment furnished by the New York City board of health, if the patient desires to do so. If a dog suspected of having rabies is to be killed, it is preferable to have it chloroformed when possible, as shooting injures the brain so as to render it of less value for examination.

If a dog suspected of having rabies bites any dogs or other animals, the animals bitten are to be quarantined by the inspector of animals, as provided for by law, and the owners must keep them under restraint until notice of their release is sent them by the Chief of the Cattle Bureau.

The police or other dog-licensing authorities should be particularly stringent in enforcing the dog license law. All homeless or ownerless dogs should be killed. All persons owning dogs should be made to have them licensed, as provided for by law; and all dog owners should feel a greater sense of responsibility at this time than when usual conditions prevail.

AUSTIN PETERS,
Chief of Cattle Bureau.

STATE HOUSE, BOSTON,
(Dated) 1905.

______________________________ *Inspector of Animals.*

Town of ______________________________

A copy of the following circular letter has also been sent to persons having dogs quarantined, and to the local inspectors of animals in towns where dogs have been placed in quarantine: —

COMMONWEALTH OF MASSACHUSETTS,
CATTLE BUREAU OF THE STATE BOARD OF AGRICULTURE.

NOTICE.

To Dog Owners, or Persons in Charge of Dogs quarantined, in Order to prevent the Spread of Rabies.

All owners or persons having charge of dogs quarantined under the provisions of chapter 90 of the Revised Laws and chapter 116 of the Acts of 1902 are hereby notified that dogs so quarantined are to be kept securely CHAINED, or shut up in a box stall or other suitable enclosure on the premises where they are quarantined; and that under the provisions of the law they cannot remove or kill any animals legally quarantined, without the permission of the Chief of the Cattle Bureau.

As dogs suspected of having been bitten by a mad dog cannot be safely allowed to run at large until the expiration of *ninety days from the time that the bite may have been inflicted*, it is possible that some owners may prefer to kill animals, to which they are not particularly attached, or that have but little value.

Permission to kill such dogs is hereby granted under the following conditions: an owner desiring to kill a dog in quarantine is to notify the local inspector of animals or an agent of the Cattle Bureau, and either the inspector or the agent is to be present when the dog is killed, and report the killing of the same to the Chief of the Cattle Bureau.

AUSTIN PETERS,
Chief of Cattle Bureau.

STATE HOUSE, BOSTON, Oct. 2, 1905.

The usual period to elapse between the time a bite is inflicted by a rabid dog and the manifestation of the disease is from three to four weeks, but instances have been known where the symptoms have not developed for several months. A quarantine of ninety days, however, seems to afford a certain amount of protection, and it is not reasonable to expect owners to maintain it for a greater length of time.

Several cases of rabies developed in Northbridge within a little over two weeks from the time dogs were bitten by the stray dog which was there July 29 and 30, three dogs with rabies being killed August 15. In one instance a dog developed the malady October 3, more than sixty days from the date he was bitten; and in another instance a hound is believed to have developed the disease in the same town December 31, or five months from the date of exposure, and two months after having been released from quarantine.

In many cases it has been considered desirable to verify the diagnosis of rabies in the laboratory, especially in instances where persons have been bitten. The method formerly employed was the intracranial injection of material from the base of the brain and spinal cord of the suspected animals into rabbits or guinea pigs, after etherizing them and trephining the skull. This method required an interval of from twelve to fourteen days before the experimental animal showed symptoms of disease; and where it was important that the person bitten should know soon whether it was necessary to obtain preventive treatment, it caused a delay that might in some instances prove dangerous.

A method by which a microscopic examination of the brain of an animal could determine at once whether it was suffer-

ing from rabies or not at the time of death became very desirable. Various scientists for some years have been conducting investigations with this object in view, with some degree of success; but it was not until 1903 that a certain means of diagnosis was discovered, when Negri, an Italian pathologist at the University of Pavia, discovered small bodies in the nerve cells in certain parts of the brain, and some of the ganglia of nerve cells outside the brain, known as the Gasserian ganglia, which had not previously been observed; these little bodies have been named, in honor of their discoverer, Negri bodies. They are constant in well-developed cases of rabies in all animals, and are not found under any other conditions. This method of diagnosis has been adopted by Dr. Langdon Frothingham in doing this work for the Cattle Bureau, and it is now possible in a well-developed case of rabies to make a positive diagnosis in a few hours, instead of waiting nearly two weeks, which was required under the method of intracranial inoculation of small experimental animals, provided the dog's head is received at the laboratory in a fresh condition, with the brain intact. In a few instances where an animal has been killed when just commencing to show symptoms of the disease, the microscopic examination has not been satisfactory, and inoculation methods have been necessary.

Fifty-three dogs' heads (in some instances the entire dog), 1 cat, and the brains of 1 cow and 2 calves have been received at the bacteriological laboratory of the Harvard Medical School for examination. Of these, 35 dogs were found to have been rabid, 13 were negative cases, and 5 dogs' heads were too mutilated and decomposed to be of any value for examination; the cat proved to be a negative case; 1 cow and 1 calf were positive, and the examination of the other calf's brain proved unsatisfactory.

The laboratory work, and the necessity of employing one agent nearly all the time on field work, and at times two agents, has occasioned a considerable expense to the State; but it is hoped that the necessity for dealing with the outbreak, and the results achieved, have more than justified this.

Experiments have recently been made in Italy in the treatment of rabies with radium, but it is too early at present to predict what success may be attained by this means.

It is probable that rabies will continue to cause more or less trouble for a year or two longer before it can be finally extirpated; and then it can be easily reintroduced at any time, as demonstrated by the dogs which have developed it after arriving from Pennsylvania and Virginia, and probably by the beast that appeared in southwestern Massachusetts recently, which in all probability came from Connecticut, as there is at present an outbreak of rabies reported in Winsted and Torrington in Litchfield County. A rabid dog will frequently run a long distance in a short space of time. One owned in Grafton disappeared at noon one Sunday, and Monday morning was found in Kingston, Plymouth County, a distance of about fifty miles from home. Fortunately, this animal was muzzled; but it can readily be seen what an amount of damage a rabid dog may cause which has this tendency to run a long distance and bite other animals it may meet, and how in this way the disease may be carried from one State into another.

If a system could be devised requiring all dogs brought into the State to be held in quarantine for ninety days after arrival, it would practically keep out rabies after it was once eradicated; but this can only be applicable to islands like Great Britain and Australia. All dogs brought to Australia are quarantined for a suitable length of time after landing, and an outbreak of rabies has never occurred there.

In closing this portion of the report, it would not be complete without a commendation of the work done by the local authorities in co-operating with the officials of the Cattle Bureau in the labor of doing all that was possible in limiting the ravages of rabies, and thus protecting life and property. The efforts of the local inspectors of animals, police, boards of selectmen and mayors and aldermen have been in the main most efficient and praiseworthy, and the thanks of the community are due them for the manner in which they have worked with the Chief of the Cattle Bureau and his agents for the suppression of this dangerous and troublesome disease.

Contagious Diseases of Swine.

There has been very little complaint during the year 1905 of contagious diseases among swine in this Commonwealth. But 20 outbreaks of diseases of a communicable character affecting the porcine population have been called to the attention of the Cattle Bureau, and 2 of these occurred in the same herd: the surviving animals in this herd were released from quarantine in the middle of June, and about a month later were again quarantined by the inspector of animals upon the reappearance of disease among them.

Fifteen of the reported outbreaks can be classified under the generic name of hog cholera. In a few instances the animals appear to have suffered from true hog cholera or some malady bearing a close resemblance to it; in others the trouble seemed to be that form of septic disease called swine plague. These diseases involved about 1,000 swine, of which number about 350 died. The fatalities might have exceeded this number if owners had not been advised to hurry all marketable swine to the slaughter house, and realize upon them before time enough had elapsed for them to develop disease.

In outbreaks of hog cholera or swine plague the sick should be separated from the healthy, and those fit for the market should be sent to the shambles before they have time to develop the disease. When the disease subsides, the pens should be disinfected. If city swill or swill from public institutions is fed, it should be cooked before using; and all dish water containing washing powders and the like should be disposed of separately, and not be mixed with the swill. If pigs develop swine plague from putrefying swill, a change of food is a benefit to mild cases that may recover, and may also protect healthy animals from infection. If the owner of a herd of swine infected with hog cholera or swine plague is breeding animals to sell to his neighbors, the animals should all be quarantined until the disease subsides and the pens have been properly disinfected, the only exception being to allow him to remove to the slaughter house the pigs that are ready for pork, in order to save him as much loss as possible.

One lot of pigs reported from Conway as having hog cholera were found to be suffering from colds, and all recovered in a short time. Another lot of 5, quarantined as having tuberculosis, were found to be free from all indications of disease when examined by an agent of the Cattle Bureau.

Two pigs reported as being sick on Cape Cod were found to be suffering with true sarcoptic mange, and were in such a condition that the owner decided to kill them. There may have been other similar cases of a milder form in the same locality of which no complaint was received, as it does not seem likely that two such cases could be found without others occurring in the same neighborhood.

Tuberculosis is common in swine killed in abattoirs, being found not only in New-England-bred pigs but those from the dairy districts of the west, and many are condemned annually as unfit for human food. The origin of this infection is undoubtedly bovine, the swine becoming infected by being kept in barn cellars upon the manure of tuberculous cows, or fed upon milk from such cattle. Sometimes swine kept at creameries and fed skim milk and buttermilk from various herds develop tuberculosis: and an instance occurred last year where 20 swine out of a lot of 100, consigned to a pork-packing establishment in Massachusetts from a New Hampshire creamery, were condemned to the rendering tank as tuberculous. No ante-mortem cases of porcine tuberculosis have been reported at the office of the Cattle Bureau during the past year except the 5 already mentioned, which were found to be free from indications of disease.

Contagious Diseases of Sheep.

The most common diseases of sheep in Massachusetts seem to be parasitic in their nature, caused either by internal or external parasites.

Scab due to a skin parasite has not been reported during the past season.

Two flocks suffering with stomach worms were reported on Cape Cod. These worms are equally troublesome to goats, and seem to be more fatal with them than with sheep. If

sheep are kept in good condition, on high, well-drained pastures, they seem to be able to resist a few parasites, such as the stomach worm (*Strongylus contortus*), and the nodular intestinal disease due to a little nematode known as the *Œsophagostoma Columbianum;* but when a flock of goats becomes infested with the contorted stomach worm, it will often nearly destroy the flock. These parasites are not at all uncommon, and may occur in any portion of the State.

In a recent article in the "Country Gentleman," Dr. D. E. Salmon, former Chief of the United States Bureau of Animal Industry, gives the following treatment for sheep infested with stomach worms: —

Coal-tar Creosote. — The remedy which has been found most effectual and satisfactory for the treatment of sheep affected with stomach worms is coal-tar creosote. This is made into a 1 per cent. solution by mixing 1 ounce of the creosote with 99 ounces of water. The dose of this solution is 1 to 3 ounces for lambs and 3 to 5 ounces for adult sheep, according to the size of the animal. It is very destructive to stomach worms, and by repeating the dose after two or three days have elapsed, the sheep should be quite thoroughly freed from these parasites. The creosote solution is soon diluted, however, by the liquids of the stomach and intestines, and is also readily absorbed; consequently, it may not reach all parts of the intestines in sufficient strength to destroy the worms which inhabit those organs. For this reason, when the presence of intestinal worms is known or suspected, it is best to add powdered thymol to the creosote solution after the proper dose of the latter has been measured out. The dose of the thymol is 30 grains for a lamb and 50 to 75 grains for older sheep. Thymol is not very soluble, and for that reason passes through the stomach and into the intestines without being absorbed. It is therefore considered to be a remedy especially adapted for intestinal worms. By combining the coal-tar creosote and thymol we have a mixture which may be relied upon to destroy the round worms of both the stomach and the intestines, with the exception of those worms which are living within the walls of those organs, and which no medicine will reach. Gasoline has been used by many in treating sheep and lambs for stomach worms, but it appears to be less effective and not as safe as the remedies mentioned above. The dose for lambs is two teaspoonfuls, and should be given mixed

with sweet milk. The gasoline and milk should be mixed in the drenching bottle for only one animal at a time, and should be given at once, as otherwise, on account of its volatile nature, a considerable portion of the gasoline might escape. After treatment the sheep and lambs should be placed on ground which is not infected with the eggs or embryos of these worms, — that is, on ground where sheep have not run for one or two years. If placed on infected pastures, they will pick up young worms with the grass, and soon be in as bad a condition as they were before the treatment. By properly carrying out these directions it should be possible to raise lambs anywhere without serious losses from stomach or intestinal worms.

It should be borne in mind that a change from infected to non-infected pastures is important after the animals have received the treatment, as the animals become reinfected by ingesting the eggs which are contained in the surface drainage or deposited upon the grass.

Symptomatic Anthrax.

Symptomatic anthrax, commonly known as "blackleg," or "quarter evil," has occurred in several localities during the summer and autumn of 1905.

Outbreaks or suspected outbreaks of this disease have occurred in Ashby, Hubbardston, Brookfield, Princeton, Florida, Harvard and Huntington. Where owners have desired it, an agent of the Cattle Bureau has been sent to furnish protective inoculation with the "blacklegoids" prepared by Parke, Davis & Co. of Detroit. In all instances where this preparation has been used the results seem to have been entirely satisfactory. In pastures where young animals have died of symptomatic anthrax no more deaths have been reported or further symptoms of sickness been shown among the young cattle thus protected. This treatment has been applied to 5 animals in Hubbardston, where 3 deaths occurred; to 4 in Brookfield, after 3 had died; to 20 belonging to several owners in a pasture in Ashby, where 3 had died; to 11 belonging to 2 owners in Florida, where 2 deaths had taken place; and to 7 in Princeton belonging to 3 owners, where 2 young animals had died. Some of the

animals thus saved were valuable pure-breds, which would have been a great loss to their owners. It was reported that several young cattle died of blackleg in Huntington early in the summer, but there was not any request from owners there for the protective inoculation.

In Harvard there was a newspaper report that 7 young cattle belonging to a farmer there had been poisoned; but an agent of the Cattle Bureau who was sent to investigate the matter gave it as his opinion that the deaths were caused by blackleg, and were not due to poisoning.

Actinomycosis.

A number of cases of actinomycosis, or "lumpy jaw," as it is called when it occurs in one of the maxillary bones, have been reported during the year. It is caused by minute fungi, known as *actinomyces*, or the ray fungus.

When actinomycosis attacks one of the jaw bones it may in time make mastication painful, and the animal becomes emaciated and of little value. It is an act of mercy to order such a creature killed. When the disease first appears, if the animal is in good flesh it may be destroyed for beef. Actinomycosis has been treated with internal doses of iodide of potash and local applications of iodine solutions, with varying degrees of success; but treatment is not always satisfactory or certain in its results, and an ordinary animal in good condition had better go into the beef barrel than continue in the herd. Occasionally a cow develops actinomycosis in the udder; such an animal should always be slaughtered, as the milk is likely to convey the *actinomyces*, and may be a source of danger to the consumer, — at least, human cases sometimes occur, and it is not always possible to trace the source of infection. During the past year 2 cows with actinomycosis of the udder have been killed; 1 cow and 1 bull have been killed at once, with consent of the owners; and 7 animals have been released from quarantine, with the understanding that they were to be fed for beef, and slaughtered when in good condition.

Miscellaneous Diseases.

In addition to the diseases already enumerated, the Cattle Bureau is called upon each season to investigate various outbreaks of maladies of a supposedly communicable character, which it does not seem necessary to classify under separate heads.

Three appearances of suspected foot and mouth disease were reported during 1905, which upon investigation were found to be nothing of a contagious character.

Mange has been reported among horses in Hudson and Hingham. In each town 2 animals were found to be suffering from this disease. The owners were advised as to treatment, but no further action was taken.

One dog with mange was quarantined in Edgartown, but released, as the only form of mange specified as a contagious disease, within the meaning of the Massachusetts act relating to communicable diseases among animals, is sheep scab. Canine mange of the follicular variety is not uncommon in this Commonwealth.

Two or three outbreaks of an infectious septic pneumonia have been reported among cattle, but here nothing was necessary beyond advising owners as to treatment, separation of the sick from the healthy, removing the well ones to uninfected stables, and instructing those in charge as to methods and importance of disinfection.

An outbreak of an infectious disease among young chickens was reported from Woburn, but under existing laws the Cattle Bureau was not warranted in going to any expense for the investigation of this matter.

A case of anthrax reported in a horse proved upon examination to be fistulous withers; and a cow quarantined as having anthrax was found to be suffering with tuberculosis.

In making an estimate for the State Auditor of the appropriations required for the year ending Nov. 30, 1906, under authority of chapter 211 of the Acts of 1905, it has been asked that $6,500 be allowed for the salary of the Chief of the Cattle Bureau, his clerk, and office and travelling expenses; and $75,000 for the general work required for

carrying out the provisions of chapter 90 of the Revised Laws.

The request for $6,500 instead of $7,000, which was allowed last year for expenses authorized under chapter 116, Acts of 1902, is that under a new law estimates this season are for the year ending Nov. 30, 1906. The reason for asking for $75,000 this year instead of $60,000 granted a year ago for the general work carried on under the provisions of chapter 90 of the Revised Laws, is that there is a deficiency at the close of each year, and $60,000 is not enough to meet the expenses incurred.

Respectfully submitted,

AUSTIN PETERS,
Chief of Cattle Bureau.

FIFTEENTH ANNUAL REPORT

OF THE

DAIRY BUREAU

OF THE

MASSACHUSETTS BOARD OF AGRICULTURE,

REQUIRED UNDER

CHAPTER 89, SECTION 12, REVISED LAWS.

JANUARY 15, 1906.

DAIRY BUREAU — 1905.

CARLTON D. RICHARDSON, WEST BROOKFIELD, *Chairman.*
JOHN M. DANFORTH, LYNNFIELD CENTRE.
HENRY E. PAIGE, AMHERST.

Secretary.

J. LEWIS ELLSWORTH, *Executive Officer and Secretary of the State Board of Agriculture.*

General Agent.

P. M. HARWOOD.

ADDRESS, ROOM 136, STATE HOUSE, BOSTON.

REPORT.

The nature of the Bureau's work has not materially changed from that of the two preceding years. In the number of cases prosecuted, violations of the renovated butter, oleomargarine and milk laws have been as in the order named. It gives us pleasure, however, to announce that violations of these laws are, on the whole, decreasing. In 1903 the Bureau made 5,524 inspections and secured 272 convictions; in 1904, 5,594 inspections and 166 convictions; while in 1905, with 5,836 inspections, the number of convictions was but 155. The total convictions, 593 for the three years, were secured from 596 violations of law, — a net loss of but a trifle over one-half of one per cent. This year there were no cases lost.

Many calls have been made upon this department during the year for lectures, use of the stereopticon, publications, dairy demonstrations, judging of dairy stock and dairy products, etc. These have been responded to so far as time and appropriation would permit, and as a result an increased amount of educational work has been done.

There has been no change in the membership of the Bureau. C. D. Richardson, reappointed by Governor Douglas, has remained as chairman; P. M. Harwood, re-elected by the Board of Agriculture, has continued as general agent; A. W. Lombard has served as agent, and four others have been temporarily employed. The chemical work has been done by Dr. B. F. Davenport. The summary of the work is as follows: —

Total number of inspections, ...	[1] 5,836
Number of inspections where no sample was taken, . .	4,887
Number of samples of butter and oleomargarine, nearly all purchased, ...	851
Number of samples of milk and cream, mostly purchased, .	120
Cases in court, ...	155
Meetings addressed by the chairman of the Bureau, . .	15
Meetings addressed by the general agent, ...	21

Cases prosecuted during the year, by months and courts, with law violated, and results, are as follows: —

Court.	Month.	Number.	Law violated.	Convicted.	Discharged.
Walpole, .	January, .	2	Renovated butter, .	2	–
Worcester, .	January, .	2	Oleomargarine, .	2	–
Holyoke, .	January, .	2	Renovated butter, .	2	–
Quincy, . .	January, .	4	Renovated butter, .	4	–
Fall River, .	February, .	15	Renovated butter, .	15	–
Haverhill, .	March, .	4	Renovated butter, .	4	–
Lowell, . .	March, .	30	Renovated butter, .	30	–
Lowell, . .	March, .	5	Oleomargarine, .	5	–
Charlemont, .	March, .	1	Milk, . . .	1	–
Gloucester, .	March, .	6	Renovated butter, .	6	–
Worcester, .	April, .	8	Renovated butter, .	8	–
Worcester, .	April, .	2	Oleomargarine, .	2	–
Fitchburg, .	April, .	6	Renovated butter, .	6	–
Boston,[2] . .	April, .	1	General food laws, Boron preservative,	1	–
Boston,[2] . .	April, .	18	Renovated butter, .	18	–
Cambridge, .	May, . .	4	Renovated butter, .	4	–

[1] Twenty-two extra samples were taken during inspections, therefore this total is twenty-two less than the sum of the next three items.

[2] In connection with milk inspector of Boston.

COURT.	Month.	Number.	Law violated.	Convicted.	Discharged.
Worcester,[1] .	May, . .	8	Oleomargarine, .	8	–
New Bedford, .	June, . .	4	Renovated butter, .	4	–
New Bedford, .	August, .	4	Renovated butter, .	4	–
Haverhill, .	August, .	6	Milk, . . .	6	–
New Bedford, .	September, .	3	Oleomargarine, .	3	–
New Bedford, .	September, .	2	Renovated butter, .	2	–
Worcester, .	October, .	8	Oleomargarine, .	8	–
Peabody, .	November, .	1	Milk, . . .	1	–
Pittsfield, .	December, .	5	Renovated butter, .	5	–
North Adams, .	December, .	4	Renovated butter, .	4	–
Totals, .	. . .	155	. . . .	155	

[1] In connection with milk inspector of Worcester.

The charges in the several cases in court for the year have been as follows: —

Selling renovated butter in unmarked packages, ...	118
Boron preservative in renovated butter, ...	1
Oleomargarine in imitation of yellow butter, ...	17
Oleomargarine sold as butter, ...	2
Oleomargarine sold in unstamped wrappers, ...	5
Oleomargarine sold without a license.	1
Oleomargarine sold without registering, ...	1
Milk below standard, ...	8
Interference with an officer, ...	2
Total, ...	155

The following is a list of inspections without samples and the number of samples taken in the years 1900–1905 inclusive: —

Year.	Inspections without Samples.	Samples taken.
1900,	1,612	826
1901,	1,757	911
1902,	3,895	1,078
1903,	4,135	1,395
1904,	4,456	1,157
1905,	4,887	971
Totals,	20,742	6,338
Averages,	3,457	1,056+

The following is a list of the number of cases entered in court and also the number of convictions secured in the years 1900–1905, inclusive: —

Year.	Total Cases.	Convictions.
1900,	178	144
1901,	252	218
1902,	285	238
1903,	289	272
1904,	168	166
1905,	155	155
Totals,	1,327	1,193
Average convictions,	–	199—

OLEOMARGARINE.

According to statistics of the Treasury Department at Washington, the output from the factories of the United States for the past six years is as follows: —

		Pounds.
Under the old law,	1900,	107,045,028
	1901,	104,943,856
	1902,	126,316,472
	1903,	71,804,102
Under the new law,	1904,	48,071,480
	1905,	49,880,982

In Massachusetts the Dairy Bureau had in court for violation of the oleo laws: in 1900, 178; in 1901, 215; in 1902 (new national law going into effect during this year), 90; in 1903, 56; in 1904, 22; and in 1905, 26.

There are indications that certain peddlers in this State are also manufacturers, in the sense that they buy uncolored oleomargarine, color it and peddle the same, which is not only violation of our own anti-color law, but is also violation of national laws. One such violator has served a jail sentence, imposed by the United States courts during the year.

There are also indications and even statistics which show that oleomargarine does not meet with great popular favor in its uncolored (natural) condition, but that its sales depend to a large extent upon the retailer being able to pass it off as butter, when colored in imitation of the latter article. For instance, the output of artificially colored oleomargarine in 1904 was 1,639,102 pounds for the whole country; in 1905 the output was 3,284,850 pounds, an increase of 1,645,743 pounds, which nearly covers the 1,809,502 pounds total in-

crease over the previous year, leaving but 153,784 pounds as the increase of uncolored goods during the year.

The oleomargarine business needs watching all the time.

The number of persons who paid a United States tax the past four years is shown by the following table: —

Years ending June 30.	Wholesale.	Retail.
1903 (colored),	1	24
1903 (uncolored),	7	314
1904 (colored),	–	17
1904 (uncolored),	9	326
1905 (colored),	–	4
1905 (uncolored),	9	138
Current year (colored),	–	4
Current year (uncolored),	10	120

Renovated Butter.

The business of manufacturing renovated butter is still on the increase in this country, so far as the total output is concerned; but, according to Secretary Wilson, "The law [national] has not proven in any way detrimental to the makers of country butter, whose product forms the bulk of the stock worked up in factories." The same authority reports an improvement of quality in renovated butter. The Commissioner of Internal Revenue at Washington reports that the output of process or renovated butter for the year ending June 1, 1905, was 61,366,400 pounds as against 55,747,736 pounds for the preceding fiscal year. The same report shows a falling off in the number of factories of about 30 per cent.

The real value of our State law lies in securing honest dealing, quite as much as in the protection of dairy interests; and the condition as we have found it during the past

two years is encouraging, inasmuch as the number of cases of violations of the renovated butter law found in this State during 1904 and 1905 together were 35 less than the number in 1903.

Educational.

For the past three years this Bureau, through lectures delivered by its general agent, and otherwise, has been encouraging the farmers to produce a better dairy product, especially a cleaner milk. We believe that it is for the interest of the dairyman, as well as for every one else that this be accomplished, and we do not believe that the production of clean milk is a prohibitively expensive operation. There can be no nobler work done by any one than improving the quality of food for our people, especially such an important and universal food as milk, thus adding to the health, happiness and general welfare of the human race. Milk can never be too clean or in too good condition for human consumption. The mortality of young children is yet far too high, especially in our large cities. Every possible effort should be made on the part of an intelligent public to improve this condition.

But, meanwhile, let us not be unmindful of existing facts, — facts sometimes overlooked when this question is considered, — one of which is, that there has been a constant improvement in the quality and condition of milk furnished the peddlers for the city of Boston for the last thirty years at least. Of this we have personal knowledge. The general public little realizes the efforts put forth during that time by the various milk contractors and others to urge better care at the farms, and these same contractors have spared no expense to improve their own plants year after year, by adding latest and most up-to-date appliances.[1] Only those who have personally observed through the period mentioned know these facts; the general public has hardly kept informed. Then, too, a considerable number of well-known, public-spir-

---

[1] Mr. Tower, late of the firm of C. Brigham Company, spent most of his time during the last few years of his life in going about among farmers and improving conditions at the stables, and as a result many separate milk rooms were built.

ited individuals have come to the front in recent years, with their sanitary dairies; agricultural colleges and experiment stations have done their work; the national government has issued circulars and bulletins; farmers' institute lecturers and grange speakers have expostulated; physicians and city boards of health have been active; not to forget the work now being done by the various State departments. All these have yielded results, until it is safe to say that not only has the condition of the milk supply of the city of Boston improved steadily for the last thirty years, but never before was the public so sure of getting a fairly clean article as it is to-day; and it may reasonably be questioned whether Massachusetts has a peer among all her sister States in the quality and marketable condition of her milk supply, though perhaps far from perfect at that. This to our mind is encouraging, and also the very best argument for still better farm conditions.

Of course there are some filthy dairies, — dairies perhaps where owners should and may go out of the business for lack of requisite neatness of habit, and most dairies can be improved; but it seems that the time is at hand when the shafts of reformers should be also aimed at consumers in our cities and towns, to the end that the milk be properly cared for and suitably prepared for consumption, and that the milk producer be not called upon to bear undue share of blame for child mortality. He certainly may have much to answer for, but he is not to blame for neglected children, filthy rooms, stuffy atmosphere, cold milk, irregular meals, improper or insufficient quantity, the lashes of poverty or the whims of fashion, both of which often place the child in the hands of a third and more or less disinterested and not unfrequently incompetent person, — and many other things which might be named. The campaign of true progress is the one which keeps ever in view the mutual benefit of both producer and consumer; thus making no undue demands or reflections upon the one, and observing the rightful needs of the other. It is along this line that this Bureau is conducting its educational work. We have during the year offered many suggestions, some of which at least have been adopted:

and we have received, both verbally and by letter, very cordial appreciation of our efforts.

In support of our contention of an improved condition, we quote from the last annual report of the Boston Board of Health. In 1875, 43.84 per cent of all the deaths were of children under five years of age, and in 1904 the percentage was 28.87; under one year of age in 1875 the percentage was 24.98, and in 1904 it was 20.52. Thus it will be seen that the death rate among children under five years has been reduced in that time practically one-third, and of children under one year about one-fifth. Of course milk is not the only cause of this decrease, any more than it is the cause of the entire mortality; but as 80 to 85 per cent of children are brought up on cow's milk, this food may possess the controlling influence.

Taking the State as a whole, we find that in 1875 the death rate of children under one year per 1,000 living at that age was 226.56, and in 1900 it was 190.10, — an improvement of nearly one-sixth. In 1875 the death rate of children under five years of age per 1,000 living at that age was 73.96, and in 1900, 57.79, — a reduction of practically one-fifth.

These figures for 1900 and 1904 are the latest obtainable, and 1875 is taken for comparison because it was in that year that the firm of C. Brigham Company opened up a fresh milk supply in Barre, Hardwick and New Braintree, which was the beginning of our experience with the milk business of Boston. We realize that figures such as these are at best simply pointers, but it is gratifying to know that they all point in the right direction.

The price paid the farmer to-day is practically the same as in 1875. The quality of the milk has been much improved, as has been shown. Is not the farmer, then, in a fair position to demand a better price, as a matter of justice, and can such demand, in any spirit of justice, be refused?

Butter.

The butter market of 1905 has been in some respects remarkable. The appended tables, relating to the Boston market, virtually tell the story. With but about five and

one-half million pounds on hand Jan. 1, 1905, nearly two million pounds less than the year previous, followed by four successive months of light receipts and consequent high prices, the arrival of May witnessed the beginning of unparalleled receipts, which continued, with the exception of November, unbroken throughout the year, leaving, after unprecedented consumption, a stock on hand of ten million pounds, or almost double the amount on hand the year previous. High as butter was during the early part of the year, the average price for the year is below that for 1902 and 1903, but is well above the average of 1904. As a result of the high price in the early part of the year, there was a stimulated activity in "imitations," which resulted in increased prosecutions wherever the law was broken.

The following table shows the average quotation for the best fresh creamery butter in a strictly wholesale way in the Boston market for the last eight years: —

	1905. Cents.	1904. Cents.	1903. Cents.	1902. Cents.	1901. Cents.	1900. Cents.	1899. Cents.	1898. Cents.
January,	28.0	22.7	28.0	25.0	25.0	29.5	21.0	22.5
February,	31.6	24.6	27.0	28.5	25.0	26.0	24.0	21.5
March,	28.0	24.1	27.0	29.0	23.0	27.0	22.5	22.0
April,	29.1	21.6	27.5	32.0	22.0	21.0	21.0	22.5
May,	23.9	19.9	22.5	25.0	19.5	20.5	19.0	18.0
June,	20.7	18.4	22.75	23.5	20.0	20.5	19.0	17.5
July,	20.6	18.3	20.5	22.5	20.0	20.5	19.0	18.5
August,	21.6	19.1	20.0	21.5	21.0	22.5	21.5	19.5
September,	21.2	20.8	22.0	23.5	22.0	22.5	23.5	21.0
October,	22.1	21.5	22.5	24.5	21.5	22.0	24.0	21.5
November,	23.0	24.1	23.5	27.0	24.0	25.0	26.5	21.0
December,	23.9	25.7	24.5	28.5	24.5	25.5	28.0	21.0
Averages,	24.47	21.73	26.23	25.0	22.3	23.5	22.4	20.5

The Chamber of Commerce's figures regarding the butter business in Boston for 1904 and 1905 are as follows: —

	1905. Pounds.	1904. Pounds.
Carried over,	5,612,592	7,567,360
Receipts for January,	2,097,952	2,345,447
Receipts for February,	2,015,265	2,400,922
Receipts for March,	2,698,064	3,087,017
Receipts for April,	2,393,951	2,658,679
Receipts for May,	5,260,758	3,776,547
Receipts for June,	10,696,890	8,076,244
Receipts for July,	10,068,394	8,513,155
Receipts for August,	10,376,813	7,480,505
Receipts for September,	7,743,859	6,512,408
Receipts for October,	6,549,119	4,554,447
Receipts for November,	3,135,224	3,238,005
Receipts for December,	3,688,555	2,791,828
Total supply,	72,337,436	63,002,564
Exports for twelve months, deduct,	2,551,319	1,373,815
Net supply,	69,786,117	61,628,749
Stocks in storage December 30, deduct,	10,189,575	5,612,592
Consumption for twelve months,	59,596,542	56,016,157
Increase in consumption for 1905,	3,580,385	

Milk.

There is considerable variation in the price of milk, as now sold in Massachusetts. The retail price of average market milk throughout the State varies from 5 to 8 cents per quart. In Boston, "fancy" or "sanitary" milk, so called, sells at from 10 to 12 cents per quart and upward.

Milk sold by the half-pint jar at 5 cents means 20 cents per quart; that sold by the glass at 5 cents, usually the same. At 10 cents per glass, holding one-third quart, the price rises to 30 cents per quart; and sanitary milk, modified and put up by prescription for babies' use, ranges from 25 to 50 cents per quart. In the suburbs of Boston the usual price which the householder has to pay is 7 to 8 cents for average milk, and 9 to 10 cents for sanitary milk. There is a constantly increasing number of small dairies springing up among the wealthy fancy farmers in the eastern part of the State, which are producing sanitary milk and cream, and getting an extra price for it. Even a few farmers of limited means are now undertaking the project, as a business venture.

There is also variation in the wholesale price of milk, which the producer receives, dependent mainly upon his distance from market. The farmer who sells milk to Boston contractors is paid according to his distance from market, the average distance being 56 to 76 miles; and, as may be seen by the tables, the average price to the farmer in this zone for milk delivered to his local railroad station is 26½ cents in summer and 28½ cents in winter, provided he does not exceed his limit (see footnote with table); but in case the contractor returns clean cans, ½ cent each is, under the present contract, to be deducted for washing. The farmer is obliged to put up 8½ quarts for a can. Thus his average price per quart through the year is 27½ cents, divided by 8½, or practically 3¼ cents at the railroad station or 3 cents at the farm. Farmers 150 miles out get 2.88+ cents per quart, and those 25 miles out get 3.47+ cents per quart, for average milk. In some instances producers wholesaling their milk direct to peddlers get 4 to 4½ cents per quart for it.

High-class sanitary milk is rarely ever wholesaled. In the only case we know of the price quoted was 8½ cents, which was said to pay expenses, but yielded no profit.

There is no question but that the average price for average milk, which really means the bulk of all the milk sold in Massachusetts, is too low, so far as the return to the producer is concerned; and it is undoubtedly true that no important food is cheaper than milk, at present prices. Even

the consumer can easily afford to pay an increased price for the better article of milk now demanded.

The following table shows the wholesale price of milk sent to the Boston market for the last ten years: —

Summer Price.

	Gross Boston Price. Cents.	"Straight Price," Boston. Cents.	Gross to Producer, Fifth Zone. Cents.	Straight Price to Producer, Fifth Zone.[1] Cents.
1896, April to October, .	33	-	22	-
1897, " " .	31[2]	-	22	-
1898, " " .	31	-	22	-
1899, " " .	31	-	22	-
1900, " " .	33	-	24	-
1901, " " .	33	31	24	22
1902, " "	36 in April, July, August, September. 35 in May, June.	34 in April, July, August, September. 33 in May, June.	27 26	25 24
1903, " " .	37½	35½	28½	26½
1904, " " .	37½	35½	28½	26½
1905,[3] " " .	37½	35½	28½	26½

Winter Price.

	Gross Boston Price. Cents.	"Straight Price," Boston. Cents.	Gross to Producer, Fifth Zone. Cents.	Straight Price to Producer, Fifth Zone.[1] Cents.
1896–7, October to April,	35	-	24	-
1897–8, " "	33[2]	-	24	-
1898–9, " "	33	-	24	-
1899–0, " "	33	-	24	-
1900–1, " "	37 to January. 35 to April.	-	28 to January. 26 to April.	-
1901–2, " "	36 40 in December.	34½ 38½ in December.	27 31	25.5 29.5
1902–3, " "	39½	37½	30½	29
1903–4, " "	39½	37½	30½	28½
1904–5, " "	39½	37½	30½	28½
1905–6,[4] " "	39½	37½	30½	28½

[1] The price in the fifth zone, *i.e.*, the middle territory, is approximately the average price which the producers receive for their milk.

[2] This is a nominal rather than an actual change. With the dropping of the Boston price 2 cents the distance discount-schedule was also lowered 2 cents, so that producers received the same price.

[3] The so-called Knapp tables, allowing a variation of 16⅔ per cent either way from the given basis of uniform production, were made a part of this year's contract. Should the producer exceed this limit, up to a certain point the penalty is that he is obliged to take 1 cent less per can for his entire month's production; if he exceeds that point or second limit, another cent less and so on.

[4] It was agreed that in case the cans were washed and returned clean, ½ cent per can should be deducted.

Creameries and Milk Depots.

Appended we give a revised list of the principal creameries and milk depots owned and operated by Massachusetts individuals and corporations. There are in this State, in addition to these, a number of distributing plants for creameries owned and operated in other States. For instance, the Maine Creamery Company of Bangor, Me., has offices at 12 Foster Wharf, Boston. The Turner Centre Creamery of Auburn, Me., has distributing houses in Boston, Worcester, Taunton and Lowell, and ships to these points butter, cream, and to one at least skimmed milk.[1] The New England Creamery of Livermore Falls, Me., distributes through a Massachusetts company of the same name in Everett, which also distributes the "Hampden Creamery" goods. The Lyndonville Creamery of Lyndonville, Vt., has a plant at Watertown, from which it distributes milk, cream and butter. J. L. Humphrey, Jr., has four plants, one each in New Bedford, Fall River, Taunton and Brockton, for the distribution of butter and renovated butter (and sometimes cream) from his Iowa creameries. The Armours, Swifts, Hammonds, Morrises and other large packing houses, all representing western-made goods, distribute quantities of butter and renovated butter from their numerous establishments scattered over the State. Some of these also put out oleomargarine. Besides these, there is a considerable number of creamery companies and so-called creameries which buy their stock of producers in this and other States. These in the aggregate do a large business. Other private dairies or creameries also have town offices, restaurants, etc.

---

[1] Pasteurized skimmed milk and cream are put together in the proper proportions required for standard milk, in the Boston plant, and the milk thus made is placed upon the market.

Creameries and Milk Depots in Massachusetts.

Location.	Name.	Co-operative or Proprietary.	Superintendent or Manager.
Amherst,	Amherst Creamery,	Co-operative,	F. J. Humphrey, agent.
Amherst,	Fort River,	Proprietary,	E. A. King.
Amherst,	Dairy School, Massachusetts Agricultural College.	Educational,	Prof. W. P. Brooks, director.
Ashfield,	Ashfield Creamery,	Co-operative,	Geo. G. Henry.
Belchertown,	Belchertown Creamery,	Co-operative,	M. G. Ward, president.
Boston, 494 Rutherford Avenue,	H. P. Hood & Sons,	Proprietary,	H. P. Hood & Sons.
Boston, 793 Boylston Street,	Walker-Gordon Laboratory Company.	Proprietary,	Walker-Gordon Laboratory Company.
Boston, 556 Rutherford Avenue,	D. Whiting & Sons,	Proprietary,	D. Whiting & Sons.
Boston, 388 Rutherford Avenue,	Boston Dairy Company,	Proprietary,	Boston Dairy Company.
Boylston,	Adelphia Creamery,	Proprietary,	E. M. Laws.

Creameries and Milk Depots in Massachusetts — Continued.

Location.	Name.	Co-operative or Proprietary.	Superintendent or Manager.
Bridgewater,	Plymouth County Creamery,	Proprietary,	S. Neilson Houlburg.
Cambridge, 158 Massachusetts Avenue.	C. Brigham Company,	Proprietary,	C. Brigham Company.
Charlemont,	Charlemont Creamery,	Proprietary,	T. M. Totman.
Cheshire (P. O., Adams),	Greylock Creamery,	Co-operative,	C. J. Fales, president.
Cheshire,	Highland Creamery,	Proprietary,	Clayton W. Prince.
Cheshire,	West Shore Creamery,	Proprietary,	Seth W. Curtis.
Chester,	Chester Creamery,	Co-operative,	W. S. Wilcox.
Conway,	Conway Creamery,	Proprietary,	Boston Dairy Company.
Cummington,	Cummington Creamery,	Co-operative,	S. W. Clark, president.
Easthampton,	Hampton,	Co-operative,	W. H. Wright, treasurer.
Egremont (P. O., North Egremont),	Egremont Creamery,	Co-operative,	H. O. Harrington.
Everett,	Hampden Creamery Company,	Proprietary,	Hampden Creamery Company.

Framingham (P. O., South Framingham).	Echo Farm Company,	Proprietary,	W. E. Marchent.
Fitchburg, 26 Cushing Street,	Fitchburg Creamery,	Proprietary,	G. S. Learned.
Gardner,	Boston Dairy Company,	Proprietary,	Boston Dairy Company.
Groton,	Lawrence Creamery,	Proprietary,	Myron P. Swallow.
Heath,	Heath Creamery,	Proprietary,	I. W. Stetson & Son.
Hinsdale,	Hinsdale Creamery,	Co-operative,	B. C. Bliss.
Lee,	Lenox Creamery,	Proprietary,	P. A. Agnew.
Leominster,	Leominster Creamery,	Proprietary,	G. H. Wass.
Marlborough,	Este's Creamery,	Proprietary,	F. F. Este.
Monson,	Monson Creamery,	Proprietary,	W. C. Moulton.
Montague,	Montague Creamery,	– [1]	A. M. Lyman.
Monterey,	Berkshire Hill Creamery,	Co-operative,	D. A. Campbell.
New Boston,	Berkshire Creamery,	Co-operative,	N. H. Snow, president.

[1] Leased and operated by Tait Bros., Springfield.

Creameries and Milk Depots in Massachusetts — Concluded.

LOCATION.	Name.	Co-operative or Proprietary.	Superintendent or Manager.
New Salem (P. O., Millington),	New Salem Co-operative Creamery Company.	Co-operative,	W. A. Moore.
North Brookfield,	North Brookfield Creamery,	Proprietary,	H. A. Richardson.
Northfield,	Northfield Creamery,	Co-operative,	L. R. Smith.
Orange (P. O., North Orange),	North Orange Creamery,	Co-operative,	C. E. Dunbar.
Shelburne Falls,	Shelburne Falls Creamery,	Proprietary,	Cressy & Campbell.
Southborough,	Deerfoot Farm,	Proprietary,	S. H. Howes, manager.
Southfield,	Maple Lawn,	Proprietary,	A. C. Lockwood.
Springfield,	Springfield Milk Association,	Co-operative,	F. B. Allen.
Springfield,	Tait Bros.,	Proprietary,	Tait Bros.
Uxbridge,	Farnum Creamery,	Proprietary,	Geo. A. Farnum.
Warren,	Worcester County Creamery Association.	Co-operative,	F. N. Lawrence, treasurer.

Westfield (P. O., Wyben),	Wyben Springs Creamery,	Co-operative,	C. H. Wolcott.
West Newbury,	West Newbury Creamery,	Co-operative,	R. S. Brown, treasurer.
Williamsburg,	Williamsburg Creamery,	Co-operative,	E. T. Barrus, president.
Worthington (P. O., Ringville),	Worthington Creamery,	Co-operative,	M. R. Bates, superintendent.
Worcester,	Wachusett Creamery,	Proprietary,	E. H. Thayer & Co.

EXPENSES.

The following is a classified statement of the expenses for the year: —

Bureau: compensation and travelling expenses,	$488 92
Agents: compensation,	1,953 00
Agents: travelling expenses and samples purchased.	2,493 12
General agent: travelling and necessary expenses,	501 32
Chemists: analyses, tests, court attendance,	864 50
Printing and supplies,	195 18
Educational,	503 96
Total,	$7,000 00

P. M. HARWOOD,
General Agent.

Accepted and adopted as the report of the Dairy Bureau.

C. D. RICHARDSON.
JOHN M. DANFORTH.
HENRY E. PAIGE.

SECOND ANNUAL REPORT

OF THE

STATE FORESTER.

REPORT OF THE STATE FORESTER.[1]

To the General Court.

This office was established to promote the perpetuation, extension and proper management of forest lands within the Commonwealth, both public and private. Its activities for the year 1905 are briefly reviewed below, and some notes are included on work or conditions not directly under its supervision, but germane to the general duty of the office.

Personnel of the State Forest Service.

There have been two additions to the service during the year. The present organization is as follows: —

Alfred Akerman, M.F., . .	*State Forester.*
Ralph C. Hawley, M.F., . .	*Assistant State Forester.*
Leverett Bradley, . . .	*Agent.*
Walter K. Fobes, . . .	*Clerk.*

Besides those named above who are regularly employed, an assistant in the woods, or office, is occasionally employed in case of emergency.

Course in Forestry at the Agricultural College.

The course of lectures provided for in the act creating the office of State Forester was given for the first time in February and March, 1905. Twenty-nine men elected the course.

This course is designed to prepare prospective farmers for the management of their wood lots. It is not designed to fit men for the practice of the profession, which usually takes two or three years of close application after the undergraduate courses have been finished. The course at the Agricultural College would no more fit a man for the practice

[1] House Document, No. 350, 1906.

of the profession of forest engineering than a short course in home sanitation would fit a man to practise medicine. Attention is called to this matter at the present time, because a good may inquiries have been received as to the purpose and scope of the instruction at the college.

Public Lectures and Addresses.

Besides the lectures at the Agricultural College, 32 public lectures, talks and addresses on forestry have been given during the year, making a total of 43 since the office was established. It is believed that these lectures afford an excellent means of awakening and sustaining public interest in forestry; therefore, as many invitations as were consistent with the discharge of other duties have been accepted, but it has been impossible to meet all of the demands. At times dates have been booked over a year in advance.

One of the encouraging features of this line of endeavor is that interests which are apparently widely divergent can find common ground in forestry. This is another illustration of the truth expressed by President Roosevelt, that forestry "touches the republic on almost every side, — political, social, industrial, commercial." Among those applying have been granges, farmers' institutes, firemen's associations, women's clubs, church clubs, boards of trade, town improvement associations, forestry associations and manual training associations.

Publications.

Two bulletins and three leaflets have been published during the year. The first editions of all these, except one, have been exhausted, and they are being revised for second editions. The number of pieces published is 9,300.

The State Forest Library.

Numerous additions have been made to the library during the year. Nearly all of these have been gifts, and they represent very little expense. In selecting those works that it has been expedient to purchase, care has been exercised to avoid unnecessary duplication of books already in the State Library or in the library of the State Board of

Agriculture. The library has not only been of great value to the forest service, but many visitors have made use of it during the year.

It is very pleasant to record in this connection the loan, by the Appalachian Mountain Club, of a set of United States geological reports, many of which deal with forestry.

The State Forest Nursery.

By authority given in chapter 409 of the Acts of 1904, a forest nursery has been established on the grounds of the Massachusetts Agricultural College at Amherst. Through an inexplicable delay on the part of the trustees of the college to act in the matter, work on the nursery did not begin last spring until all the good land available for the nursery had been assigned to other purposes. The only ground left was the worst for a forest nursery that there is on the college grounds. Rather than throw away the seeds that had been collected the nursery was begun. In spite of the adverse conditions, the nursery will furnish a few thousand seedlings for distribution the coming spring, and some 25,000 in the spring of 1907. The nursery will be expanded until an annual output of 125,000 seedlings has been reached.

Practical Assistance to Owners of Woodlands.

The offer of practical assistance which the Commonwealth makes to owners of woodlands has been responded to with alacrity. Forty-six applications have been received; 34 of these, representing 6,545 acres, have been examined by the forester and his assistants, and advice in regard to their proper management has been given.

This, as well as the other branches of the work, has been hindered considerably by the impossibility of the present force to make examination promptly upon application. The owner who is about to cut his timber and who wishes to cut in such a way as to insure reproduction, or the owner who is about to plant and wants advice on the care of seedlings, species suited to his soil, and the like, ought not to be required to wait until a man becomes available. This and other lines of work would become much more effective if

sufficient appropriations were made to allow an increase in the number of men employed.

Growth Studies.

Investigations into the rate of growth and yield of white pine have been begun in collaboration with the United States Forest Service and the Forestry Department of Harvard University. Over 400 stem analyses have been taken, and the elaboration of this data has been begun. This investigation will be of great practical value to this office in the construction of working plans; it will also be of value to lumbermen and owners of woodlands.

Travel.

During the year a record of travel on duty, such as making wood lot examinations, lecturing, investigating problems, etc., has been kept; it is quoted as an indication of the extent of activity of the service: —

	Miles.
State Forester,	7,058
Assistant State Forester,	6,475
Total,	13,533

A Forest Map.

As stated in last year's report, the collection of data for a forest map has been undertaken in collaboration with the Bureau of Statistics of Labor. This work is under way. It will not be possible to make a definite report in regard to it until next year.

Co-operation with the United States Forest Service.

The plan of co-operation between this office and the United States Forest Service, which was outlined in last year's report, has continued in force. The plan has proved advantageous to both parties.

Office Facilities.

The drafting room of the service, 247A, has been useless since October. The temperature in this room has ranged between 50° and 60°, rarely reaching 60°. It is manifestly

unreasonable to expect men to do physically inactive work under such conditions. The consequence is, that plans which should have been completed several months ago are still unfinished.

The matter has been brought to the attention of the Sergeant-at-Arms repeatedly, and once to the attention of the Council; but at this writing nothing has been done to heat the room. This matter should be investigated at once, and if it be impossible to make the room comfortable, sufficient appropriation should be made to rent a room outside the State House.

The Gypsy and Brown-tail Moths.

The presence in the Commonwealth of the gypsy and brown-tail moths in large numbers continues to be a menace to our forests. During the year the Commonwealth has made provision for work against the moths by appropriating $330,000, and the appointment of a superintendent to administer the fund. Energetic work has been begun; and, although the situation continues to be serious, those interested in our forests view it with a decided sense of relief.

Expenditures and Receipts.

As provided in section 6 of chapter 409 of the Acts of 1904, the State Forester may spend annually in carrying out the provisions of the act a sum not exceeding $5,000. The expenditures have been as follows: —

Salaries of assistants,	$1,918 05
Travelling expenses (not included in co-operative funds),	398 96
Instruments,	658 53
Stationery, office supplies,	669 24
Printing,	198 31
Postage,	118 70
Miscellaneous,	36 74
	$3,998 53
Balance on hand,	1 47
	$4,000 00

In addition to the above, bills to the amount of $388.91 remain unpaid, as the appropriation for 1905 was only $4,000.

Receipts from the United States for services rendered amount to $189.17, which amount has been turned over to the Treasurer and Receiver-General.

As directed in section 5 of the act above cited, a statement is also made of the amounts received for travelling and subsistence expenses of the forester and his assistants, while engaged in woods work for owners of woodlands, and lecturing, as follows: —

Benjamin S. Blake, Auburndale,	$0 21
N. I. Bowditch, Framingham,	3 37
Overseers of the Poor, Palmer,	5 85
L. N. Cushman, Hubbardston,	2 30
F. S. Coolidge, Pittsfield,	6 34
R. S. Goldsbury, Warwick,	1 00
Wm. Franklin Hall, Winchendon,	7 01
J. C. Hammond, Northampton,	2 25
J. M. J. Legate, Charlemont,	4 20
City of Marlborough,	1 27
Mattapoisett Improvement Association,	3 56
Pomona Grange, No. 1,	1 25
Pomona Grange, No. 16,	1 55
Men's Union, Worcester,	2 10
North Shore Horticultural Society, Manchester,	1 39
Roland C. Nickerson, East Brewster,	23 10
Frank K. Nash, Williamsburg,	15 70
North Reading Grange, No. 239,	61
Jas. S. Russell, Milton,	35
South Dartmouth Improvement Association,	2 75
W. J. Stone, Worcester,	5 54
W. S. Spaulding, Pride's Crossing,	98
Mrs. John Swann, Stockbridge,	44 74
Turner Hill (estate), Ipswich,	1 50
Tyngsborough Grange, No. 222,	2 75
Vineyard Haven Improvement Association,	3 35
Wachusett Mountain Commission,	5 07
Wheelwright Paper Company, Wheelwright,	2 11
Fiske Warren, Harvard,	2 09
George A. York, New Bedford,	3 05
Total,	$157 34

On deposit with the State Forester: —

Francis B. Greene, Dartmouth,	$10 00
Carrie D. Hosmer, Orange,	3 00
Hampshire Pomona Grange, No. 8,	2 00
Total,	$15 00

The Taxation of Woodlands.

There is a great deal of dissatisfaction with the present method of assessing taxes on forest lands. This dissatisfaction is shown by the laws that the different States are enacting along these lines. Pennsylvania has a rebate system; if a private owner will fulfill certain conditions, he receives a portion of his taxes back after they have been paid. Connecticut, Massachusetts and other States also have special laws in regard to the taxation of certain classes of woodlands. For the most part these laws are not operative because they were not carefully thought out. They serve to show the feeling of discontent with the present system, but they do not furnish a satisfactory solution of the problem.

The system, now generally in vogue, of assessing forest lands for the purposes of taxation, provides for the taxation not only of the land but of the growing crop as well. A farmer's wheat crop is not taxed while it is growing. An orchard or a vineyard yields returns in a very few years, but the wood lot is oftentimes taxed for years before any returns come in. Suppose, for example, a piece of land is planted to white pine, which is to be cut fifty years from now. As soon as that pine has reached a size at which it adds any value to the land, the property is assessed accordingly until it is cut, when it is again put back to the value of the land without the crop. In other words, the present system provides for the taxation of a raw material not only once, but many times. When this raw material is so universally used in our manufactures, such heavy taxation is of doubtful expediency, granting it to be fair, which it is not. It hinders the increase of wealth by taxing it at its source.

So there is dissatisfaction for two reasons: first, the crop as well as the land is taxed, which is not the case with ordi-

nary agricultural crops; and, second, the crop is taxed while it is not bringing in anything, and therefore the owner is not in a condition to pay taxes on it.

Governor Douglas in his inaugural address recommended to the General Court that laws be enacted providing for a fairer method of taxation of forest lands; and a bill was also introduced by private parties. As the General Court did not feel that it had sufficient time to investigate the question thoroughly at the last session, a resolve was passed calling for an investigation of the laws of other States and foreign countries, and the conditions of this State. Pursuant to this resolve a committee was appointed, consisting of the Tax Commissioner, the chairman of the Harbor and Land Commission, the State Forester, three farmers, and a real estate expert. This committee has been hard at work during the summer and autumn. The laws of foreign countries have been collected, translated and carefully examined; those of this State and other States have been gone over thoroughly. It is believed that such a thorough investigation of this problem has never before been made in this country, and the findings of the committee are worthy of the most careful consideration.

It is recommended that the General Court amend the present tax laws in such a way as to relieve the growing timber crop of the unfair burden under which it now labors. This relief must be given before the average private owner will be disposed to allow his timber crop to stand long enough to reach its productive maturity.

The need of reform along this line is emphasized by the fact that most of the woodlands of the Commonwealth are in the hands of private owners, and the private owner's actions are influenced largely by self-interest. Although the State may acquire certain lands for State forests, still, the great body of woodlands will always remain in the hands of private individuals. Now, it is to the communities' interest that private holdings should continue to produce, generation after generation, the greatest possible amount of useful material; and the individual owner should be given every reasonable chance to harmonize his interests with those of the community.

A reform in our tax laws as applied to woodlands would be a step towards bringing individual and public interest together.

State Forests.

The Commonwealth ought to extend its policy of park reservation to include genuine State forests. The reservations that have been made so far are distinctly for park purposes; there are, however, considerable areas in these reservations that could be used for timber growing. Portions of the Middlesex Fells and the Blue Hills reservations might be so utilized without any reduction in their value as parks; on the contrary, their park features would be enhanced. The same might be said of Mount Wachusett, Mount Tom and Greylock reservations, the Province Lands on the Cape, and the land surrounding the Clinton reservoir. The land about this reservoir is already being planted by the Metropolitan Water and Sewerage Board. The forest in the Mount Wachusett Reservation is also being improved by the commission, which has that reservation in charge. It is to be hoped that all of the boards and commissions having State lands under their charge will follow these good examples, and make the lands that the State owns as productive of forest supplies as is consistent with the purpose for which they were acquired.

But the lands mentioned are small in area, and the State might well follow the precedent established by several other States, and acquire lands for the purpose of growing timber on them. New York has a forest reserve of 1,436,000 acres, and Pennsylvania has acquired 572,000 acres for forest purposes. New Jersey, Connecticut and other States have also adopted reservation policies.

Lands for forest reservations can very often be acquired at a small cost. A few years ago Connecticut bought 900 acres at an average cost of only $1.64 per acre. In Massachusetts they could be had for $5 and under. There are large areas of overgrown, stony, abandoned pastures, cut-over lands that have been burned repeatedly, scrub oak lands and the like, that are in such condition that an individual owner cannot afford to improve them. The State can

afford to bring these lands into productivity for the common weal. When once well stocked, the sale of mature timber should not only provide for the maintenance of such reservations, but should return a net revenue into the treasury of the State. Some of the European governments obtain as much as $4 net per annum from each acre in State forest.

In addition to their use for timber production, such reservations furnish recreation grounds for the people. This use for recreative purposes under reasonable restrictions is not inconsistent with the production of timber. The arguments which caused the Commonwealth to appropriate $6,380,000 for the metropolitan parks and considerable sums for the other State park reservations apply in part to the acquisition of State forests.

The educational effect of well-managed State forests is one of their chief advantages. They should, as far as is consistent with their economical management, be widely distributed over the State, in order that they may serve as object lessons in practical forestry.

It is therefore recommended: —

1. That a fund for the purchase and maintenance of State forests be set aside.

2. That revenues from the State forests be added to the fund.

3. That the State Forester be charged with their purchase, care and management.

4. That the State Forester be empowered to accept gifts of land and money for State forests, subject to the approval of the Governor and Council.

Respectfully submitted,

ALFRED AKERMAN,
State Forester.

BULLETINS

MASSACHUSETTS BOARD OF AGRICULTURE,

PUBLISHED IN

MASSACHUSETTS CROP REPORTS, 1905.

BUSH-FRUITS.

BY PROF. FRED S. CARD, PROFESSOR OF HORTICULTURE, RHODE ISLAND COLLEGE OF AGRICULTURE AND MECHANIC ARTS.

The bush-fruits represent a type likely to be neglected, though one well worthy of consideration in most localities. They ought by all means to appear in every home garden, and in many places would prove desirable market fruits. Many New England markets are poorly supplied with these fruits, and where conditions are favorable to their growth, they might prove a source of profit to numberless local growers.

Judging from our experience at the Rhode Island Experiment Station, some of them do not thrive well near the shore, being especially subject to winter-killing.

Two general classes of fruits are included under the term bush-fruits, differing in their botanical relationships and habits. The brambles, which include the raspberries and blackberries, are the ones most likely to suffer from unfavorable climatic conditions here in New England. The groselles, which include the currant and gooseberry, are seldom injured by cold, and generally succeed, though the English gooseberry cannot be depended upon to thrive. Owing to their different characteristics, it seems better to treat these two groups separately.

The Brambles.

Soil and Climatic Conditions.

The brambles are not particular in their soil demands. It is chiefly necessary that the soil shall not be wet, nor too dry. On heavy, wet soils they will not thrive, and are very subject to winter-killing. On a light, dry soil they suffer from summer drought, and the fruit does not reach its full

size and flavor. With suitable moisture conditions the particular type of soil is of only moderate importance.

Medium fertility is best suited to their needs. This is particularly true of the red raspberries and blackberries. While blackcaps will prosper on a rich soil, the red raspberries and blackberries are likely to make a rank growth, suffer from winter-killing and yield a small amount of fruit.

The climate best suited to their growth seems to be one neither too humid nor too dry. A humid climate appears to induce more winter-killing. The same result may be brought about by an unusually dry climate, such as we find on the plains of the west, to which is added the injury from summer drought. Winter-killing is not governed entirely by temperature. Our winter temperatures in Rhode Island seldom get much below zero, and are never so severe as in the interior of New England, yet these fruits will pass the winter with much less injury in the colder interior than with us. Laying down and covering the plants during winter will sometimes afford a sufficient protection, particularly in cold climates. With us it has not proved uniformly successful. Either the protection has been insufficient, or the injury was done before the plants were put down. In many northern localities, however, this practice is regularly followed, and must give good results.

One rather strange fact with regard to winter-killing is that the smaller, late-growing canes seem to pass the winter better than the larger and apparently more mature ones, which have grown during the entire season. This suggests a possible means of reducing winter injury by pulling out all the first young canes when well started, and allowing the later ones to take their place. Why these small canes are more hardy than those of earlier growth I am unable to say, but I have observed this to be the fact in several instances.

The site, or particular elevation of land chosen, is sometimes of great importance. Not only frosts are more frequent on low lands, but the cold of winter is also more intense. Plants may therefore escape injury on high lands which would be severely hurt in the valley near by. We find these conditions often marked on our college farm,

though the difference in elevation is but little. A series of temperature records taken last winter often show differences of six and eight degrees in the minimum temperature between different points chosen on the farm. At times the extremes were even greater than this.

Fertilizers.

How to fertilize bush-fruits is to some extent a still unsolved problem. Some tests made in our experiment station work gave very conflicting and unsatisfactory results. If stable manure is available, it can always be safely used to a limited extent. Blackcaps will make use of a liberal supply to good advantage, but it must not be used in too large amounts for red raspberries and blackberries, particularly if the soil is already fairly fertile. This may be supplemented with potash in any convenient form, since, like all other fruits, the bush-fruits are benefited both in yield and quality by this element. If chemicals alone must be depended upon, it is largely a question of personal trials, to learn what will give best results under the given conditions. Judging from theoretical reasons, as well as from some hints derived from our trials here, I am inclined to believe that nitrogen in the form of blood or tankage may give better results than nitrogen in the form of soda. This is only a suggestion, and may not prove true under general conditions.

Preparation and Planting.

Ordinarily deep and thorough preparation of the soil is all that these fruits demand, unless upon land which requires underdraining. With a heavy soil, retentive of moisture, underdraining should prove as profitable with these crops as with others. Sod land should be avoided because of the greater difficulty and uncertainty in planting; old sod may also be infested with white grubs, which may cause considerable loss of plants.

The distance apart for plants may vary with the kind of fruit and the preference of the planter. Raspberries will do well with rows six feet apart, and the plants three or four feet apart in the row. Some successful growers prefer to

make the rows of blackcaps seven feet apart. Blackberries need more room. Seven or eight feet apart is none too far for the vigorous-growing varieties.

The methods of planting are simple. In a large way, it can be most conveniently done by plowing a furrow where the row is to be, and setting the plants with the hands in this furrow. Only enough earth to fully protect the plants need be thrown into the furrow, leaving the remainder to be filled in by subsequent cultivation.

The selection of varieties is largely a personal and local matter. Each grower should take the fruit of his choice, if it will thrive in his locality. Some varieties are generally successful, while others thrive only in limited areas. Varieties of blackcaps have changed more than those of the other classes, and those sorts which were most prominent fifteen years ago are little grown now, except perhaps in the evaporating industry. Kansas and Nemaha are two which have done well in our trials, one being early, the other late. With red raspberries Cuthbert is still the leader. This is a late berry, too dark in color; but as yet I have looked in vain for an earlier and brighter berry which is equally good. In some parts of New England I am told that the Phœnix is giving good satisfaction as an earlier berry, but there is no well-tested kind that can rank with Cuthbert. In blackberries Snyder is the hardiest sort, but not of good quality. Taylor is a much better berry, and nearly as hardy. Early Cluster is a fine early variety, which has given good satisfaction with us, but which is not uniformly popular.

Some varieties of brambles are greatly helped by being planted in proximity to other kinds, so that interpollination may take place. This may be more important than we think, even with varieties which do not absolutely need it. It is a simple thing to do in any case, and is a point always worth considering. All these fruits often show small and imperfect berries, due to the fact that too few of the pistils of a given bloom have been fecundated.

Methods of Propagation.

Propagation of the brambles is simple. The suckers which are freely thrown up by raspberries and blackberries are most frequently used for planting. Plants may also be produced by root cuttings, when necessary. It is sometimes claimed that root cuttings make better plants, but I have never been able to verify such claims.

While generally planted in spring, as one-year-old canes, they may also be moved in summer when growing, in the same manner that tomato plants would be handled. The blackcaps require some attention if many plants are to be obtained from them. The canes take root readily from the end when growing in their natural habitat, among weeds and grass; but in the cultivated field they are often kept in such constant motion by the wind that they do not have an opportunity to root. When the canes begin to thicken and assume a snake-like appearance, they should be buried deep enough to hold them in place, when they will readily root. Pinching the growing canes early, while still low, thus inducing the formation of low branches, will make it possible to obtain more plants than otherwise.

After-culture.

The same tillage which would be given a cornfield is suitable for a bush-fruit plantation. A cultivator which runs shallow and leaves a fine earth mulch should be chosen. It is important that this mulch should be kept in perfect condition, since so much of the success of the crop depends on an adequate moisture supply during the heat of summer, when the fruit ripens. For the early spring cultivation in subsequent years a heavier cultivator may be needed. In some cases a plow is used, but this should be avoided when possible, and if needed should be run very shallow.

The introduction of a cover-crop, as is now so frequently done in orchards, possesses some advantages among bush-fruits, the chief difficulty being in destroying the crop the following spring. In our experiments here a plat which was sown with a cover-crop in August gave decidedly better

results than an adjoining portion without a cover-crop. In most of New England mammoth clover will prove a more reliable plant for this purpose than crimson clover. The advantage of clover is that it adds nitrogen as well as humus, and with a good growth little or no nitrogen will be needed in the fertilizer. The past spring mammoth clover on our grounds showed a uniformly strong, bright green cover, while crimson clover was nearly all dead. Some winters the latter will go through with little harm.

Whether to keep blackberries and red raspberries in hills, or allow them to form hedge rows, must be decided soon after tillage begins. Under favorable conditions, hills give good results; but with us hedge rows have yielded much better. The cultivator should be kept close to the rows, to prevent the hedge from becoming too wide. In older plantations some thinning out may be desirable, but this is expensive, and should be avoided. It is usually better to replant in a new location rather than spend much time in thinning an old hedge.

Pruning.

Pruning methods differ. Some prefer to let plants of all varieties grow their own way during the summer, merely thinning out and cutting back the canes the following spring. My own preference is to pinch back the growing shoots of blackcaps and blackberries while they are still low, not over eighteen or twenty inches high. This induces them to branch and form a self-supporting bush. Such a bush is not so easily laid down for winter protection as when each cane is left unpruned; it also demands more work in the spring pruning. There is likewise a further objection, that it forms a more compact plant, which does not dry out so quickly when in leaf, and is therefore apparently more subject to the spread of plant diseases. Anthracnose is more troublesome upon plants treated in this way than upon those allowed to grow as single canes. For the home garden, if a trellis is to be provided, to which the canes may be tied, it is doubtless as well to let them grow in their own way. Red raspberries give best results in either case if no summer pruning is done. It is important that this pinching be done

early, for if the canes are allowed to grow tall before being cut back, the results are never so good.

The fruiting habit of the variety should be considered at the spring pruning. It should be remembered that that pruning is the fruit-thinning process with these fruits. The amount of cane left determines the amount of fruit to be borne. Some varieties differ noticeably in the position of the first fruit-bearing clusters. In some cases there may be double the number of non-producing buds at the base of the branch that will be found in others. If the grower does not know his variety, therefore, the spring pruning had best be delayed until the fruit buds show, so that he can know how many buds he is leaving.

Harvesting and Marketing.

Harvesting is a small matter in the home garden, but is likely to be the most troublesome of all in commercial plantations. It is absolutely essential that the commercial grower shall have a liberal supply of pickers available, in order to succeed. The work is tiresome and trying, and many who begin with the best of intentions will not persist to the end of the season.

In the picking of blackberries it is important that the fruit should be kept from the sun, since exposure to the sun, after being taken from the bush, quickly turns the fruit red, greatly injuring its appearance. Another point to be remembered with the blackberry is that for the best quality it should not be picked too soon. The fruit is not really ripe when it first turns black. In commercial practice it may be necessary to pick it then, but for home use it should be allowed to remain longer upon the plants.

Packages should be chosen with reference to the taste of the market to be supplied. People usually prefer a package to which they are accustomed, though the grower who is to work up a special, high-class retail trade may prefer a package different from ordinary ones. These fruits are easily crushed, and handle best in small baskets. Red raspberries, particularly, demand pint baskets, and are sometimes sold in even smaller ones. The grower should avoid long ship-

ments, if possible. These fruits settle so badly in transportation that they appear at a great disadvantage at the end of a long journey.

Enemies.

The brambles are subject to attacks from many enemies. One which often proves troublesome upon blackberries is the bramble flea louse, known as the "mistletoe disease" in some localities. This is a small plant louse, which attacks the tips of the growing shoots in large numbers, causing both the cane and the leaves to curl up, forming a knotted mass of foliage. The insects themselves are so well protected by this abnormal growth that they cannot be readily reached with any insecticide. About the only remedy consists in cutting off and burning these deformed tips.

Several cane-borers attack these plants, some working at the crown, others in the canes about. They, too, can only be controlled by destroying the canes before the insects have emerged, thus preventing their future multiplication. Where rose chafers are numerous, they often become a troublesome pest, and one which it is very hard to control. Thorough spraying with Bordeaux mixture and arsenate of lead will destroy many of them, but they are likely to appear at a season when it will be impracticable to use this preparation. Perhaps the best that can be done is to avoid their breeding places in the location of bush-fruit plantations. Sandy lands which are known to be infested should be avoided.

The strawberry weevil is a pest very common on wild blackberries. Its injury is done by cutting off the young fruit buds before they open. In a count made of a number of clusters of wild blackberries one season, more than half of the buds had been thus destroyed by this insect. Practically nothing can be done to prevent its ravages. It is not likely that it eats enough in doing this work to be seriously checked by poisons. Its purpose in this operation is to hold the pollen of the unopened bud in a condition to afford food for its offspring, since the young larva feeds upon pollen. Thus far we have not experienced serious loss upon cultivated plants from these insects, perhaps because they have

been located some distance from woodlands where wild blackberries grow. It is said to fluctuate greatly in numbers in different years, so that it might not always prove so troublesome, even if it were to attack cultivated plants. Avoiding proximity to wild blackberry lands would seem to be a safe precaution to take.

Among the fungous diseases red rust is one of the best known. It causes the plants to look red and scaly soon after growth begins in the spring. This red color is caused by the ripening of a large number of spores upon the surface of the leaf. A plant once attacked is thoroughly diseased, since the mycelium works its way throughout the whole plant. The only remedy is to uproot and burn all such plants at once.

Another troublesome enemy is anthracnose, which causes many canker-like spots upon the canes and even leaf stalks of the plants. These spots often become so numerous as to run together, and greatly hinder the growth and productiveness of the plant. Diseased canes should be avoided in setting a new plantation. The simplest remedy is to replant frequently. The pest is nearly always more troublesome upon old plantations than upon young ones. With good care and frequent replanting it seldom becomes a serious handicap. Its ravages can be reduced by thorough spraying with Bordeaux mixture, but this is not as feasible as in the case of some plant diseases.

Leaf spots sometimes cause serious injury. Bordeaux mixture will be more useful in controlling them than with anthracnose, but is not often necessary.

Another troublesome pest is the crown gall, which causes the growth of warty galls on the roots. These growths may occur just at the surface of the ground, or at points further underneath. The disease is due to the work of a fungus of low order, and may be communicated from one plantation to another, or from berry plants to fruit trees. It is therefore best to exercise great precaution to avoid introducing this trouble, especially if the plants are to be set among trees in the orchard. Plants affected soon grow weak and fail to yield satisfactory results.

The Groselles.

Soil and Climatic Conditions.

Like the brambles, the groselles are not sensitive to variations in soil, though the best returns can be expected from a moist, fertile soil, fairly heavy. They will thrive better on clay than the brambles. They are cool-climate plants, and do better in cool locations, such as a north slope. Currants are frequently planted in orchards, and give good results under these conditions. A wet soil is unfavorable, because it tends to induce heaving in winter. Currants in particular are easily lifted and seriously injured by this cause.

These plants are particularly hardy, and seldom or never suffer winter injury, at least under conditions prevalent in Southern New England. They are, however, subject to injury from summer drought, though this is likely to be less serious than with the brambles, for the reason that their fruit develops earlier. A lack of moisture will reduce the size of the fruit, hence for best returns a moist soil and good cultivation should always be the aim.

Fertilizers.

Both currants and gooseberries delight in a rich, fertile soil. Stable manure is well adapted to their needs, and no commercial fertilizer will give superior results. Experiments in Massachusetts some years ago showed that the quality of the currant could be improved by the liberal use of potash. Since the fruit is developed so early in the season, nitrate of soda should prove a satisfactory source of nitrogen when chemicals must be used.

Preparation and Planting.

The preparation of the soil does not differ from that suggested for the brambles. Underdraining will prove equally important in the case of wet soils liable to heaving. This will not only avoid such injury, but also afford better moisture conditions during the season of growth.

A convenient distance for planting is six feet by four, and

if planted in check-rows cultivation may go on in both directions, thereby reducing the amount of hand-hoeing to the minimum. Methods of planting are the same as for the brambles.

Among varieties of currants there is no such unanimity of choice as with the red raspberries. No one variety seems to be the best adapted to all localities. In many places Fay is one of the best, while in others it does not seem to give good satisfaction. Cherry, while large in berry, is likely to be small in bunch. Versailles is generally reported more reliable. Among late varieties, Victoria is one of the best and very generally successful. There are many new claimants to public favor, some of which may in time take the place of older ones.

White currants are little wanted in the market, and should seldom be planted for market purposes. They are slightly sweeter than red varieties, and a few may be desirable for home use.

Among gooseberries two classes are to be considered, the American and the English types. These differ widely in their characteristics. The English gooseberry is far larger, and consequently more attractive in market, though no better in quality, if, indeed, equal to the American. It is only with exceptional care and under favorable conditions that this type will succeed in America. A few amateurs have reported excellent success with it. With us, in Rhode Island, none of the varieties of this class have proved at all satisfactory. One by one they disappear as the winters go by, and there is little to show for the effort to grow them. The gooseberry mildew is thought to be the chief enemy responsible for this failure, but not all the difference in hardiness may be due to injury from this cause. Under our conditions the type is far less productive than the American sorts. The weak point of the American varieties is the small size of their fruit. As yet, however, this class must be depended upon under most conditions for commercial work. Downing is still our most popular and most uniformly successful variety. It is believed to contain some European blood, but the native element predominates to

such an extent that it is a very hardy and reliable sort, producing fruit of fair size and excellent quality. Some of the newer sorts promise well, and may, in time, take the place of this well-tried variety. Among these, Pearl is a promising one with us.

I know of no experiments to determine the desirability of interpollination among currants and gooseberries. It is a fact, however, that many blossoms fail to set fruit, and it may be possible that interchange of pollen would prove beneficial. This failure to set fruit is frequently noticeable with the currant in short clusters, the end blossoms having failed to set.

Methods of Propagation.

Currants are among the most easily propagated of all our fruits which demand any attention at all in this regard. Currant cuttings will grow under almost any method of treatment. To propagate a few for home use, as simple a way as any is to make cuttings of the one-year-old wood early in spring, and plant them directly in the soil. If done before growth starts, which must be early, a large proportion of them will root and form plants.

In more extensive planting the cuttings are usually made in the fall, as soon as the leaves drop, or even earlier, usually about the first of September. The cuttings are made six or eight inches long, and may be planted at once or tied up in bundles and buried, bottom upward, just beneath the surface of the ground. In this condition they will readily callous at the base, and may be taken up and planted later. When planted they should be set with only an inch or so of the tip above the ground, and be covered with a mulch during the winter. Cuttings taken at any time during the winter and buried in moist moss, earth or sawdust in a cellar will be in good condition for planting early in spring.

Gooseberries do not root so readily from cuttings as do currants, though with proper care there is little trouble in propagating the American varieties in this way. Probably one of the best ways is to take the cuttings in the fall or early winter and keep them in the cellar, as suggested for currants, until planting time, though they may be planted out in autumn in the same manner as currants.

The English varieties root with great difficulty, and are therefore propagated by mound layering. This is done by banking the earth up about the bush in spring and allowing it to remain there until roots are thrown out from the base of the branches. Some of the English sorts will require to be left in this condition for two years before being sufficiently rooted for the branches to be cut off and set out by themselves. The American varieties will form roots readily, and can be cut into separate plants the following spring after being mounded. They may also be propagated by ordinary layering, bending a branch down and covering it with soil until it roots. This is less convenient than the other method, and not so generally practised.

After-culture.

Frequent, thorough, but shallow tillage is all that these fruits demand. The roots of these plants are readily injured by implements which run deep, and their use should be avoided.

The use of a cover-crop is as applicable to currants and gooseberries as to raspberries and blackberries. Several rows of currants on our own grounds had an excellent stand of mammoth clover during the past winter and spring. This was cultivated and hoed out with some difficulty after making a good start this spring. It has been noted that these plants are now making an unusually good growth. How much of this is due to the influence of the clover we are unable to say. Certainly no injury has resulted from it.

Pruning.

The pruning of currants and gooseberries is simple. When first planted, if the growth has been rapid, the branches may be shortened back at the spring pruning; but under ordinary conditions the pruning consists chiefly in thinning out superfluous stalks or branches. For the first year or two the young wood may be removed; after that it is chiefly a question of removing the older parts, to give place to young growth. The best fruit is always borne on the young wood. It is well, therefore, to keep a perpetual process of renewal under way, so that at no time shall there

be any parts of the bush which have begun to weaken with age. As with the brambles, this spring pruning is the fruit-thinning process, and the amount of wood left should determine the probable amount of fruit which the plant is to bear. For exhibition purposes it may be practicable to thin individual fruits or clusters, but under general conditions thinning is done wholly by the pruning.

Harvesting and Marketing.

In harvesting currants for market purposes a particularly close watch must be kept of the pickers. The stem of each cluster should be grasped above the fruit, and removed from the bush without crushing or loosening any of the berries. Only careful pickers will do this. It is so much easier to grasp the cluster of fruit as a whole and pull it away than it is to take hold of the stem alone with the thumb and finger. For this reason a variety which affords more space between the branch and the first berries of a cluster possesses an advantage. Fay is a good variety in this respect. While currants will stand shipment well if sound, they will quickly spoil when torn from the stem and the skin broken.

Gooseberries are among the best of all our fruits to ship, since they are nearly always marketed green. They can be handled like so many beans, and will always stand up well under ordinary shipping conditions. They are, however, difficult to pick, since the plants of all our good varieties are thorny. These thorns are stiff and strong, and particularly troublesome to the pickers. One method of picking sometimes practised, which obviates the difficulty in part, is to wear gloves, and strip the fruit from the bushes into trays or dishes. They are then run through a fanning mill to blow out leaves and other light refuse. If picked while still perfectly green and firm, this method is entirely feasible.

The five or ten pound grape basket makes a very convenient and satisfactory package for marketing these fruits, particularly gooseberries, though they are often marketed in the ordinary quart basket.

Enemies.

Among the enemies of the groselles, the San José scale should perhaps receive first mention, since it seems to be very partial to the currant as a food plant. This pest is now so thoroughly established and so generally distributed in New England that we must reckon with it as one of our standing enemies. We may be fortunate enough to escape it for a time, but are liable to meet it at any time. It can be controlled by spraying with the lime, sulphur and salt mixtures which are now so generally used, and by several other methods. The recommended methods for dealing with this pest have changed so rapidly in recent years that it is probable that we have not yet found the best plan of treatment. It is true, however, that the lime, sulphur and salt is proving an efficient remedy, though one somewhat troublesome to prepare.

Currant borers sometimes cause serious injury to these fruits. The only feasible remedy is to cut out and destroy infested stalks. When the principle of frequent renewal in pruning is followed, there is not likely to be serious loss from this pest. The older method of growing the plants in tree form, with a single stalk, rendered the possibility of damage from this insect much greater than it is under the present more general custom of allowing a number of stalks to grow from each root.

The currant fly sometimes causes serious trouble. This insect deposits its egg within the growing fruit. The larva which hatches may work from berry to berry, destroying the appearance of the cluster, and rendering it practically worthless for market purposes. Unfortunately, the only remedy which seems available is to pick off and destroy infested fruits as soon as the insect is known. This, though a somewhat expensive process, may be really more feasible than at first glance it appears to be, provided help can be obtained to do the work.

The currant worms, of which there are two species, one native and the other imported, are the best-known enemies of these fruits. They are, however, easily controlled.

Powdered hellebore, at the rate of an ounce to three gallons of water, is an efficient and particularly feasible remedy. The eggs are usually laid near the base of the plants, and if spraying is done very early, Paris green or arsenate of lead may be used, destroying many of the worms before they spread to other parts of the plant.

Gooseberry mildew, as already suggested, is the chief enemy of the English gooseberry. It also sometimes attacks the Downing. It is a fungous disease which makes its appearance first on the leaves, covering them with a dirty grayish growth. It may later attack the fruit as well, rendering it unfit for use. Destroying the leaves, as it does, it weakens the plant and prevents it from making growth or elaborating food for the next year's crop. The best and simplest remedy is thorough, frequent spraying with potassium sulphide, known also as liver of sulphur, used at the rate of one ounce to three gallons of water. This is a simpler and more effective remedy than our standard fungicide, Bordeaux mixture, though the latter is also a fairly efficient remedy.

Leaf-spot fungi are also troublesome to both the currant and the gooseberry. It is the common occurrence for these plants to lose all their leaves long before the summer is over. This greatly weakens their condition. When thoroughly sprayed with Bordeaux mixture the leaves may be held on much later, with consequent improvement in the vigor and general condition of the plant.

PROFITS.

Profits with any of the bush-fruits depend much upon location. Several things are essential to profitable returns. Among these are: first, favorable soil and climatic conditions; second, available help for picking; third, an available market. With these essentials given, to which must be added intelligent care and management, any of these fruits will prove fairly remunerative. Instances of exceptional profit, such as are often reported, give little estimate of probable returns, but with none of these fruits need the

expense of production be unusually large, and the price obtained for good fruit is always sufficient to cover it with a satisfactory margin beside. Failures will come, as with everything else, but they need not be more frequent than in other lines. With any of these essentials lacking, however, the growing of bush-fruits for market is a hazardous undertaking.

THE MANAGEMENT OF MOWINGS.

BY PROF. WM. P. BROOKS, PROFESSOR OF AGRICULTURE, MASSACHUSETTS AGRICULTURAL COLLEGE.

The paper on "The hay crop in Massachusetts," prepared for the May Crop Report in 1904, treated the subject in a general but at the same time in a fairly comprehensive way. The writer is now asked to present a second paper on the same topic, and to go into greater detail concerning certain branches of the subject. Owing to the general nature of the first paper, there will almost of necessity be some repetitions of matter therein contained in this; but the writer trusts this will be pardoned, as such repetitions as will be made seem necessary in order to make this paper fairly complete in itself.

THE VARIETIES OF GRASSES AND CLOVERS.

There are but few of the species of grasses which have been recommended for cultivation which are well known to our farmers; and it shall be the first object of this paper to give in condensed form such information affecting the value for practical purposes of the different species as seems likely to prove most useful in the direction of enabling readers to select varieties suited to conditions.

All the different common varieties of grasses may be first divided into two great classes, which may be called respectively sod-formers and non-sod-formers. The sod-forming grasses are all capable of constant renewal by the formation of new plants between the plants first established. In the case of most of the sod-formers which will be spoken of, this multiplication of the plant is accomplished through the agency of an underground stem, similar to the well-known pointed, white and jointed underground stem of witch grass,

which is so frequently pictured as growing through a potato, for example, and which is generally so well known. These underground stems extend through and through the ground in the neighborhood of the plants from which they start. They are jointed, and provided with roots springing from near the joints. At each joint there is a bud from which a new stem pushes up into the air. From this centre a new plant is formed. This in turn produces underground stems, and the soil is gradually filled fuller and fuller of such stems, crowding through it in all directions and all sending up new stems from the joints. In the case of all the sod-forming grasses, then, the tendency is for the turf to become constantly thicker, closer and finer. The surface of the ground is completely covered, and a thick, tough sod or turf, firmly held together by the underground stems and by the roots, is formed. Grasses of this character are persistent, and they are not likely to die out under the action of natural causes nor to be crowded out by other species. Among such grasses meadow fescue and tall meadow fescue, Kentucky blue-grass, awnless brome grass and redtop are the more important.

There are a few grasses which spread and form a turf gradually thicker and thicker, by rooting at the lower joints of the stem. The stems of such grasses incline to bend near the base, so that the lowermost joint and perhaps the second joint also comes to rest on the surface of the ground. Under these circumstances, if the soil is moist, roots are sent out from the joints in contact with the ground, and thus the plant spreads and gradually forms a turf which becomes thicker and thicker with the lapse of time. The bent grasses are of this description. Grasses having this habit, like those having the underground stems which have been spoken of, are persistent.

The non-sod-forming grasses are not provided with either of these means of renewing themselves. Each plant comes from a seed. The plant, originally small, gradually increases in size, until from a single root a very considerable number of stems may be produced. In other words, these grasses stool freely. As a consequence of the stooling habit, many

of them ultimately form tufts which make the surface quite uneven. Between the tufts formed by the individual plants there may be spaces which are relatively bare. Orchard grass and sheep's fescue are prominent representatives of grasses having this habit, while the common timothy, tall oat grass, yellow oat grass and the rye grasses are less likely to form tufts, but propagate themselves only by stooling or from seed. Most of the non-sod-forming grasses are rather likely to be crowded out of permanent mowings by the sod-formers, which have an advantage in the struggle for existence.

Some of the More Important Grasses described.

Timothy. — This variety is so well known that it seems almost unnecessary to describe it, but some of the principal reasons why it is a favorite and a statement of a few of its peculiarities may be of interest. Timothy is a large, moderately coarse grass, producing relatively little leaf and a large proportion of stem. The hay made from it is comparatively coarse and strawy, but the character of its growth is such that it may be readily cured. The hay is, therefore, perhaps more certain to be free from dust than that from most grasses. It is therefore looked upon as the standard of excellence, and usually sells for a higher price than any other hay in our markets.

Timothy requires a deep, retentive loam for its best growth. On such loams, with liberal top-dressing either with manures or fertilizers supplying abundance of nitrogen, it may prove quite persistent ; but on the lighter soils and under less generous treatment timothy is likely to give way to inferior species within a comparatively short time. Just at the surface of the ground on a timothy plant which is mature will be found a considerable number of pointed and rather small solid bulbs. If these be fed off, or if the mowings be too much trampled by heavy animals, which doubtless crushes and bruises the bulbs to a considerable extent, the timothy will be seriously weakened. It is not, therefore, well adapted to grazing, and great precaution should be used in pasturing mowings in which timothy is the principal species.

Redtop. — Redtop, next to timothy, is our best-known grass. It reaches its most luxuriant development on deep, rich soils, and the best redtop that the author has ever seen in any part of Massachusetts was produced on the reclaimed salt marshes in the town of Marshfield. Redtop is a sod-forming grass, but the vigor of its underground stems is considerably less than that of some other species. Close observation has shown that redtop is capable of doing better in soils containing free acid than most other species. Under ordinary conditions it is persistent. It will endure grazing much better than timothy. It starts slowly after having been cut, and usually produces very little rowen.

Rhode Island Bent and White Bent. — These species are very closely allied to redtop, and have the same general habit of growth. Indeed, it may be doubted whether there is a well-defined dividing line, based upon distinctions of practical importance, between these three species. There are doubtless differences which are sufficiently clear to the botanist; but it is at any rate true that the product from commercial samples of seed grown in plots side by side is so nearly alike in the case of these three species that so great an authority as Professor Lamson-Scribner, formerly agrostologist of the Department of Agriculture in Washington, has frankly admitted to the writer that he could distinguish no well-defined difference between them. It would seem, therefore, that, as the seed of redtop is more generally kept and better known, it must be unwise to purchase seeds of these other species which are less certain to be of good quality, and which are as a rule sold at higher prices.

Orchard Grass. — This is one of the best known among the less common grasses. It is a large, coarse species, and is one of the earliest to come into bloom. It has the very bad habit of growing in tufts, and is characterized by the production of a very heavy growth of foliage starting from the ground, and a relatively light production of stalk and seed. It is called orchard grass, not because it will grow better in the shade than when fully exposed to the sunshine, but because it will do better in the shade than most other grasses. If it can be established in light soils it will do bet-

ter there than either the timothy or the redtop, and it is very persistent. In the writer's experience it has not seemed to yield to the pressure from any other competing species. It is often asserted that orchard grass is tough, woody or wiry; and, as this grass is frequently handled, this is undoubtedly true. This seems, however, to be due to the fact that it is not cut sufficiently early. It should not stand later than the period of very early bloom, and this stage is sometimes reached in this latitude as early as the 5th to the 10th of June. Few farmers are ready to begin haying at this time. Orchard grass deteriorates after blooming more rapidly than most species, and, as a consequence, orchard grass hay, often cut as late as the last of June, is of poor quality. Orchard grass starts quickly after being cut, but seldom comes into flower a second time during one season. Orchard grass rowen consists almost exclusively of very long, rather coarse leaves, springing from the ground; and, like the first crop, the rowen crop is not infrequently allowed to stand until these leaves have become in considerable measure brown or rusted, when it is somewhat inferior in quality.

Kentucky Blue-grass. — This species, known in some sections of the State as June grass, bears a general resemblance to redtop, although close inspection shows the two species to be in many respects quite different. Kentucky blue-grass produces a much larger proportion of leaves starting directly from the root than does redtop, and at the same time produces relatively far less stem and flower. It is also much earlier. Kentucky blue-grass has abundant underground stems, and in time forms a very close, velvety turf. It is one of the most valuable of pasture grasses, but is not a variety of the first importance for mowings, as there is little top. Kentucky blue-grass, further, has the very bad habit of producing relatively little second growth. In mowings it may be regarded as useful in filling in between larger and coarser species; but a mowing consisting largely of Kentucky blue-grass, while giving hay of excellent quality, is not likely to produce such quantity as to prove satisfactory to the best farmers. This species is best adapted to the strong, retentive soils, and reaches its highest development

in the limestone regions of Kentucky and Ohio. On the stronger soils in many parts of Massachusetts it is one of the most aggressive of species, and often in time comes to predominate almost to the exclusion of more valuable kinds. It flowers about with orchard grass.

Meadow Fescue and Tall Meadow Fescue. — These two species resemble each other so closely that they may be spoken of together, though one, as indicated by the name, commonly attains a considerably greater height than the other. These fescues are intermediate in coarseness between redtop and timothy. They produce abundant and vigorous underground stems, and are therefore aggressive and persistent species. They are best suited in strong, retentive soils, retaining considerable moisture, and in such soils the meadow fescue at least often comes in spontaneously. These grasses have a bright, clean foliage, unusually free from rust or blight, and form a very close turf. They produce abundant stem and flower, as well as leaf growth. It is the belief of the writer that farmers having soils of the kind indicated, and desiring mowings which shall be fairly permanent, will do well to give these grasses a trial.

In the paper of last year the results of a comparison of a mixture of seeds in which these species were prominent with another mixture in which timothy was most prominent in the first year after seeding were presented. Somewhat later in this paper the results of the continued comparison of the two methods of sowing in the second year will be given.

The fescues start quite quickly after being cut, and on good soils produce a fair amount of rowen. It is often stated that meadow fescue is especially well adapted for use in pastures; but an experiment in lawn-mowing this species, which it was believed would throw light on the question of its suitability for grazing, indicates that it will not endure such treatment. The lawn-mowed portion of a plot of meadow fescue in one of our experiments died out completely within about a year of such treatment, while the half plot handled as a mowing was still in perfect condition.

Sheep's Fescue, Red Fescue, Hard Fescue and Slender Fescue. — These species of the fescue order are very much

smaller and finer than the two fescues which have been spoken of. They are sometimes recommended in works on grasses; but the writer has not been convinced, as the result of considerable opportunities to observe these grasses under different conditions, that they are ever likely to prove of value in mowings. They will thrive in lighter soils than many grasses, and are very persistent. In dry hill pastures they are of possible value, because of their ability to thrive under the conditions existing there. Under no circumstances is it believed these grasses should be included in mixtures for mowings.

Tall Oat Grass. — This grass will do better on the moderately light soils than many others. In such soils it is persistent, and will make a large crop in seasons when some other species fail. The seed is large, the young plants growing from it especially vigorous; and, as a consequence, this species will take possession of the ground and make a crop within fewer weeks after sowing than almost any other. Unfortunately the seed in the markets often shows a low percentage of germination and the price at which it is held is high. Tall oat grass comes into bloom at about the same time as orchard grass, and is fairly suitable, therefore, for sowing with that grass. When the conditions as relating to farm work are such as to render it possible to secure a part of the hay crop exceptionally early, a mixture consisting largely of orchard grass and tall oat grass has much to recommend it for the lighter soils. It is asserted by some authorities that tall oat grass has a bitter flavor, which renders it unpalatable to animals; but the writer has observed no distaste for it on the part of any stock to which hay made from it has been fed. Tall oat grass starts quickly after cutting, and in favorable seasons will give three crops on rich soil.

Yellow Oat Grass. — This is a somewhat smaller and shorter species than the tall oat grass. It flowers at about the same season, and it is the belief of the writer that it is worth inclusion in mixtures made up chiefly of orchard grass. Unfortunately, as in the case of a number of the other less-known grasses, the seed often germinates poorly, and is held at a relatively high price.

Italian Rye Grass and Perennial Rye Grass. — These species of grass are said to be of the highest importance in Great Britain, and early writers upon the grass crop in America, copying to some extent from English books, frequently urged their cultivation. They seem to be less well suited to the drier climate of this country, with its more severe winters, than to Great Britain, and they are less hardy than most of our grasses. It is sometimes asserted that the perennial rye grass is much more hardy than the Italian; but, according to the writer's observation, there seems to be no great difference between the two species in respect to their ability to endure our winters. The seed of both varieties is relatively large. These species, therefore, make a quick start, and are capable of soon covering and occupying the ground. They are relatively early in coming into flower, and, while they are not sufficiently hardy to make it wise to depend upon them largely, it is the belief of the writer that a moderate amount of the seed of these grasses may wisely be included in mixtures composed chiefly of orchard grass, because of the contribution they will make, with a fairly favorable winter, to the product of the first one or two years, during which period they will help fill in between the larger and coarser orchard grass and other early species. If but one variety is to be tried for this purpose, the writer's preference would be for the Italian rye grass.

Awnless Brome Grass. — This species belongs to the same genus with some of the annual grasses which are regarded as troublesome weeds in some sections and which are known by the names of chess, cheat, etc. It has very vigorous underground stems, and it is sometimes suggested that it may be difficult to get rid of it when the land is plowed. Experience on the Agricultural College grounds indicates this fear to be groundless. Awnless brome grass is an early-flowering species, and adapted, therefore, to sowing in mixture with orchard grass and other relatively early varieties. It inclines somewhat to the wiry habit of witch grass, but if cut early makes fairly palatable hay. It is the writer's opinion that the species has been much over-praised, and yet that it is worth trial by farmers occupying the lighter and drier soils.

Sweet Vernal. — This grass, also known as June grass in some sections, is characterized by the most delightful fragrance (especially after wilting) of any of our common species of grass. Much poetical license in reference to its influence upon the quality of dairy products has been based upon this fact. In plain prose, it must be stated that this is one of the least valuable of the species commonly found in mowings. It does not appear to be especially palatable to cattle, nor is it known to exercise any especially favorable influence upon the flavor of dairy products. This species comes into mowings on the lighter soils or in dry seasons on heavier soils, and gradually displaces the more valuable timothy and redtop. There are two varieties, so-called perennial and the annual. The latter seems to have absolutely nothing to recommend it: while even the perennial sweet vernal should never, in the opinion of the writer, be included in mixtures of seeds for our mowings.

The Common Clovers described.

There are but four clovers of recognized value in our mowings and pastures, — common red, mammoth red, the alsike and the white.

Common Red Clover and Mammoth Red Clover. — These species, which are in general well known, closely resemble each other in general habit. Between typical specimens of the two there are well-defined differences; but the species seem to run together by insensible gradations, and the product of commercial samples of seed sold under the two names is often indistinguishable even by experts. The most important recognized differences between typical specimens are the following: the leaflet of the red clover is relatively broad, not very hairy, and has a whitish, approximately crescent-shaped mark on the upper surface. The leaflet of the mammoth clover is relatively narrow, elliptical, more hairy than in the common red, and is without the whitish mark. The mammoth clover is somewhat coarser and taller than the common red, and a little later in coming into flower. It is therefore looked upon as being somewhat better suited for use in mixture with timothy and redtop than is the common red, which is usually past the best stage of

development for cutting before the timothy and redtop are ready. These clovers are rather short-lived perennials; but, as was pointed out in my first paper upon the hay crop, it is possible to produce hay in permanent mowings in which these clovers will be fairly prominent indefinitely, and that without reseeding: for a portion of the heads in the rowen crop are usually ripe before this crop is cut, and the seeds scattered from these heads constantly renew these clovers. As the older plants die, their place in the mowings is taken by the young plants from these accidentally scattered seeds. The persistence of these clovers in mowings, however, is dependent, as was pointed out in the earlier article, upon a liberal supply of the mineral elements of plant food, especially lime, phosphates and potash.

Alsike Clover. — Alsike clover is intermediate in its characteristics between the common red clover and white clover, having the erect habit of growth of the red clover, but the heads shaped like those of the white are in color pink, — a blending of the red and white. Whether alsike clover was originally produced as a hybrid between the red and the white is not definitely known. Alsike clover is of much value in mowings, especially upon the stronger and moister soils, where it is better than the common red. It is considerably finer than the red, and therefore cures more easily. It is of great value as a honey plant. According to the writer's observation, however, it does not persist as long as the red, neither does it produce as heavy a second crop. It should, however, be included in mixtures of seeds for the stronger and moister soils, where hay including clover is desired.

White Clover. — This well-known plant is not often included in mixtures of seeds for mowings. Its creeping habit of growth renders it rather unsuited to this use. It is, however, of much value in all permanent mowings, into which it comes naturally if the soils are adapted to it, and if the mineral elements of plant food are abundantly supplied. In such mowings it contributes largely to the product both in quantity and in quality. It is, moreover, the most valuable of the clovers for bees.

VARYING MIXTURES OF SEEDS FOR DIFFERENT PURPOSES.

In the first article on this subject three mixtures of seeds were given, and the conditions under which each should be used were briefly discussed. It was stated in that article that two of these seed mixtures were under careful comparison at the Experiment Station in Amherst.

The first of these mixtures, spoken of as the timothy mixture, was as follows: —

Per acre: —

	Pounds.
Timothy,	18
Redtop,	8
Mammoth clover,	5
Alsike clover,	4

The second mixture, spoken of as the fescue mixture, was as follows: —

Per acre: —

	Pounds.
Timothy,	6
Redtop,	8
Kentucky blue-grass,	4
Meadow fescue,	6
Tall fescue,	4
Red clover,	5
Alsike clover,	4

These mixtures are under comparison upon a strong, retentive loam, under liberal use of manure and fertilizers. The seeds were sown in August, 1902. The crops in 1904 were respectively as stated in the first paper: for the timothy mixture, a yield in two cuts at the rate of about 5 tons to the acre; for the fescue mixture, also in two cuts, a yield at the rate of about 4¼ tons per acre. Commenting on these results in the first article, I said: "The timothy mixture is in the first year plainly superior to the other, but it is expected that the fescue mixture will maintain its quality better." The yields during the last season seem so far to have justified this expectation. The average yield on the

area sown to the timothy mixture in two cuts amounted during 1904 to 4 tons per acre. The average yield on the area sown to the fescue mixture is a very little greater than that amount. The first of the two mixtures of seed under comparison seems certain to prove most satisfactory where mowings are frequently broken up, but for more permanent mowings the second seems certain to prove superior on all the stronger and more retentive soils. A mixture adapted for permanent mowings on light soils was given in the first paper.

Other mixtures which may be valuable under the conditions indicated are the following: —

For two or three years' mowings on medium soils, per acre: —

	Pounds.
Orchard grass,	14
Tall oat grass,	6
Italian rye grass,	4
Meadow fescue,	6
Red clover,	6
Alsike clover,	2

For permanent mowings on medium soils, per acre: —

	Pounds.
Orchard grass,	8
Italian rye grass,	3
Yellow oat grass,	4
Meadow fescue,	5
Tall fescue,	5
Red clover,	5
Alsike clover,	4

Both of these seed mixtures will produce crops which should be harvested relatively early; and, unless the farmer is prepared to give them attention when the crop is in the best condition, he will do better to select a mixture made up chiefly of timothy and redtop.

The various methods of sowing grass seeds, the time of sowing and the use of manures and fertilizers in preparation for the hay crop were quite fully discussed in the first paper.[1]

[1] "Agriculture of Massachusetts," 1904, p. 357.

The Use of Fertilizers on Grass Lands.

Top-dressing grass lands was discussed at some length in the first paper on this subject. The reasons were therein given why it is believed that on most farms manures should generally be used on the tilled fields. It was pointed out that in the decay of manures on the surface there is some risk of loss of their most valuable constituent, — nitrogen. It is equally true that in the decay of organic fertilizers, such as dried blood, dry ground fish or tankage on the surface there is danger of similar loss through the escape of ammonia into the air.

Nitrate of Soda for Mowings. — It seems to be the almost universal experience that nitrate of soda is the most valuable fertilizer which can be used for the purpose of increasing the growth of the grasses proper. Grasses make most of their growth in the early part of the season, and at a time when the conditions are not very favorable for the conversion of the relatively unavailable constituents of such fertilizers as sulfate of ammonia and the organic fertilizers which have just been mentioned into compounds suitable for plant food. Nitrate of soda, as is now generally known, is in condition to feed the crop just as soon as it is brought into solution, and relatively light rains will dissolve it and carry it into the soil. Nitrate of soda is, however, so soluble that there is quite a possibility that under some conditions it may be washed through the soil and lost before the crop can utilize it. This danger is undoubtedly less in the case of the grass crop than with most others, for the grass roots absolutely fill the soil, and the soil itself is in a relatively compact condition, — unfavorable to the rapid percolation of water. The writer has in a number of instances seen unmistakable evidence, in the second season following its application, of the beneficial effects of a heavy dressing of nitrate of soda. This observation, however, was made upon soils containing a large proportion of very fine particles, and therefore naturally compact and relatively impermeable. Even in the case of such soils, however, much care should be taken to apply nitrate of soda as near as possible at the time when the crop

is ready to make use of it. It would be a mistake, especially in the case of the lighter soils, to apply nitrate of soda in early spring. It should be held until the weather is fairly settled and the grass is beginning to make considerable growth. In average seasons from about the 1st to the 10th of May will probably be found to give the largest increases in the crop. The quantity of nitrate of soda which may wisely be used in top-dressing mowings doubtless varies widely with soils. Wheeler finds that in Rhode Island applications running up to 300 or 350 pounds per acre prove profitable, and, indeed, that there is a larger profit from the use of such amounts than follows the use of smaller quantities. On some soils — and many of the fields of the college farm seem to have soils of this character — so heavy an application would usually prove inadvisable; it would render the crop likely to lodge. It has been found on the college farm that about 200 pounds per acre seem to be as large a quantity as it will pay to use. There must, of course, as will be at once understood, be a wide difference in the tendency to lodge under heavy nitrate manuring with the season, and no doubt also with the species of grass. In relatively dry seasons the heavy applications may prove useful, but in seasons characterized by frequent and sufficient rainfalls more moderate applications seem preferable. Wheeler has pointed out, as also have others, that the hay produced under heavy applications of nitrate of soda is richer in protein than that produced where less nitrate is used; but if the more liberal use of nitrate is followed by the lodging of the crop, the loss in quality due to the conditions existing must more than offset any gain due to the greater protein content.

Should Nitrate of Soda be used alone in Top-dressing Mowings? — In cases where a mowing is used in rotation for hoed crops, and where the hoed crops receive comparatively liberal applications either of manure or general fertilizers, which supply phosphates, potash and perhaps lime, and where the production of hay, which it is desired shall consist chiefly of grasses such as timothy and redtop, for market is the object, it sometimes may be wise to top-dress with nitrate of soda alone. For one or two years it is possible as large

an increase may be produced by the use of nitrate alone as by the use of nitrate combined with materials supplying phosphates and potash; but even in such cases considerable practical difficulty will be experienced in attempting to apply the nitrate evenly, and it would seem to be wise to use in connection with it some material which will keep it dry, which will dilute it, and which will therefore make it easier to distribute the nitrate evenly. In selecting a substance for this purpose, some material which is relatively low in price, naturally dry and fine itself, and which may be expected to ultimately benefit the condition of the soil, should be selected; and among such substances basic slag meal seems to be one which meets the requirements admirably. Imported slag meal can be sold in Massachusetts at about $15 per ton. From 300 to 500 pounds in connection with nitrate in such quantity as will ordinarily be required, say 150 to 200 pounds, makes a mixture which will run through the fertilizer distributer evenly; while the slag meal, although not perhaps benefiting the immediate grass crop, will help correct a tendency to acidity in the soil, and will enrich it in phosphoric acid, which is fairly available.

With a view to maintaining the condition of the soil, it would seem to be expedient in most cases to combine with the slag and nitrate a moderate amount of some potash salt, for which purpose the high-grade sulfate will probably be found best adapted. On account of the expense connected with the use of slag and a potash salt in connection with nitrate, many are tempted, in view of the fact that the nitrate alone proves so largely beneficial to grasses, to depend exclusively upon this material. It should be clearly understood that nitrate supplies but one of the more important elements of plant food, and that continued dependence upon such one-sided manuring must therefore be unwise.

On the grounds of the Agricultural College is a plot of land containing about one-half acre, which for the last five or six years has been annually top-dressed with nitrate of soda alone. The mowing is one which has not been broken up for at least twenty years, and the prevailing species is Kentucky blue-grass. The product at the present time is exceedingly unsatisfactory. The grass during its growth

shows a rather deep bluish-green color. Its growth is short, and it seems peculiarly liable to rust. Adjoining land of similar character, which six years ago was in the same condition as this half-acre, and which has been top-dressed with potash salts and slag meal in combination with nitrate, produces far heavier and more satisfactory crops. Nitrate alone, therefore, should be used for the grass crop only under exceptional conditions, and then not for many consecutive years. Two years will in most cases probably be the limit.

The Possibilities of the Hay Crop without Manures or Fertilizers supplying Nitrogen. — The fact that good crops of clover can be produced on land which for many successive years has received applications of materials furnishing of the different important plant food elements only phosphoric acid, potash and lime, was pointed out in the first paper upon this subject. In that paper the ability of clover to thrive on soils thus treated, due to the fact that it can take the needed nitrogen from the air, was especially emphasized. Attention is now called to the fact that good crops of mixed hay (clovers and grasses) can be produced under this system of manuring. A striking evidence of this fact is afforded by a number of plots on the grounds of the Massachusetts Agricultural College. It can readily be understood how good crops of clovers are possible under this system. It will not be equally clear, perhaps, to all how grasses which are known to take all the nitrogen which they require from the soil can thrive on soils to which for a long series of years neither manure nor fertilizer furnishing nitrogen has been applied. That the grasses can do this, however, has been shown both at Amherst and by the work of numerous experimenters in other parts of the United States and in Europe.

The limed portion of one plot upon the Experiment Station grounds last season, which had been annually manured with dissolved bone-black and muriate of potash for fifteen years, and the greater part of the time at the rates respectively, bone-black 320 pounds and muriate of potash 160 pounds per acre, gave the following yields: hay, first cut, at the rate of 3,600 pounds per acre; rowen, second cut, at the rate of 2,575 pounds per acre.

Here was a total crop — and on soil, by the way, which is

not typical grass land — at the rate of rather more than 3 tons per acre, at an annual fertilizer cost, covering the bone-black and muriate of potash, of about $5.50 per acre. The land, however, has been limed twice during the fifteen years, at a cost for each liming of about $6 or $7 per acre. We have, then, an annual cost for lime at the rate of about $1 per acre, making the total annual cost of the fertilizers used about $6.50. For this small expenditure we have a crop in the fifteenth year of rather over 3 tons. In the same field we have a similar plot, to which the same quantities of dissolved bone-black, muriate of potash and lime are annually applied, and in addition nitrate of soda at the rate of 160 pounds per acre. Here the two crops last year amounted to 7,600 pounds of well-made hay. We have thus an increase of some 1,500 pounds of hay as the result of the employment of 160 pounds of nitrate of soda, which would cost about $4. The use of the nitrate in addition to the bone-black and potash, therefore, is clearly profitable. It will be asked, however, Whence comes the nitrogen required by the grasses, where the dissolved bone-black, muriate of potash and lime annually are used? The answer undoubtedly is, From decaying clover roots and stubble. Clover thrives under this system of manuring. It draws nitrogen freely from the air. The clovers, however, are not long-lived plants. On their death and decay the nitrogen which had become a part of their tissues becomes available to the grasses which follow. By liberal use of phosphates, potash and lime, then, we can, if we will, in the first place produce heavy crops of clover and later heavy mixed crops of grass and clover, the grass feeding upon the products of the decay of the earliest clover plants. That this will prove the most profitable system of manuring does not follow, for, as indicated by the comparison above made, yet greater profit was consequent in the experiment under consideration from a combination of nitrate of soda with the other materials.

The Necessity for Lime. — The fact that an application of lime is frequently necessary in order to bring soil into such condition that clovers will thrive was particularly emphasized in the first article upon the hay crop. The results

in the field which has been referred to very strikingly illustrate the same point. In this field there are two plots, which for the last fifteen years have annually received equal quantities of dissolved bone-black and muriate of potash. One in addition has received during the fifteen years two applications of lime at the rate of 1 ton per acre — the first application, deeply disc-harrowed in, in 1899; the second application, put on as a top-dressing to the grass land, in the early spring of 1904. The product of the two plots was at the following rates per acre: —

Unlimed plot: —

	Pounds.
First cut,	860
Second cut,	280

Limed plot: —

	Pounds.
First cut,	3,600
Second cut,	2,575

The total product of the unlimed plot was at the rate of 1,140 pounds per acre. The total product of the limed plot was at the rate of 6,175 pounds per acre, or substantially five and one-half times the product of the unlimed plot. The grasses as well as the clovers made far more vigorous growth on the limed than on the unlimed plot.

Methods of applying Fertilizers. — In the relatively small amounts in which the concentrated fertilizer materials recommended are generally used, it is a matter of some difficulty, or rather one which requires an extreme degree of care, to apply evenly by hand sowing. There has been much inquiry for a machine which will apply fertilizers broadcast in a satisfactory manner. As a result of such experience as we have had here in the use of machines for this purpose, I conclude that our inventors have not as yet produced a machine which is altogether satisfactory. For the application of relatively small amounts of fertilizer we have for the last few years employed the Stevens' fertilizer distributer, and this, if kept in perfect order and all the working parts clean, is capable of doing fairly satisfactory work. The means whereby the amount of fertilizer applied can be gauged are

not by any means perfect. It is difficult to set the machine for a definite amount, as the quantity of fertilizer feeding through it will vary widely with the condition of the material. A machine with a more certain and positive feed would be better. For the application of fertilizers such as lime or wood ashes, in amounts approximating a ton to the acre or more, we have used Kemp's manure spreader with the slow feed with fairly satisfactory results. It is relatively easy to apply definite amounts to given areas with this machine, but the fertilizer material is likely to drop in large masses occasionally, owing to not being reached and distributed by the beater; and to avoid killing the grass in the spots where this happens, it is necessary to go over the field and scatter such fertilizer by hand.

The Care of Mowings.

While great care is commonly taken in smoothing and leveling the surface when land is put into mowings, there is a tendency to unevenness, as the result of the action of frost and other agencies, and occasional rolling is likely to prove beneficial. In the case of the non-sod-forming grasses the condition of the mowing may be better maintained if some seed is occasionally sown. The reason why timothy in some cases proves much more persistent than in others is undoubtedly because the crop is harvested so late that some of the seed is mature before the crop is cut, and the seed thus accidentally scattered helps to thicken the mowing by producing plants which replace others as they die out. The best time for sowing such seed is either late summer or very early spring. The quantity of seed sown should be varied according as conditions seem to require. In case the stand of plants in a mowing is especially thin, and it is desired to reinforce it, it may be wise to go over the mowing either with a harrow or a weighted weeder after sowing the seed.

The Common Weeds of our Mowings.

A considerable proportion of the mowings of the State are infested with weeds of different kinds. Among the most common and troublesome are the common white and the

yellow daisy, wild carrot, sorrel, dock, buttercups, the common plantain, dandelions, milkweed, ragged robin and horsetail. The methods which will prove most effective in eradicating these weeds or keeping them in subjection must be quite different in details for the different weeds; but in general it may be said that, if the soil is kept sweet by sufficient use of lime, and well enriched, the conditions will be made so favorable for the growth of the better grasses and the clovers that the weeds will have relatively little chance. The grasses and the clovers, in the struggle for existence which is always going on in the meadows, will prove victorious. There are localities, however, where certain weeds have gained such a foothold that special measures of eradicating them are called for. There is one general measure which may be expected to prove helpful in the case of almost any of them, which must be first considered. This is reseeding.

Reseeding Mowings.

The question is often asked, when mowings become highly infested with different weeds, how these weeds can be best subdued or eradicated. Reseeding in almost all such instances, if carried out under the right conditions, is likely to prove helpful. The question will at once arise whether it is better to plow and cultivate for one or more years and then reseed, or to plow or otherwise break up the ground and immediately reseed. Experience in reseeding mowings in a field having a rather strong, retentive soil, which had become much infested with white daisy, buttercups, ragged robin and a few other species, convinced me that the best results are likely to be obtained by breaking up the land in midsummer, harrowing it repeatedly and most thoroughly until early in August, — so frequently and so thoroughly as to keep the surface absolutely free from vegetation, — then enriching liberally and reseeding, sowing seed in very liberal amounts. The seeds of most weeds, if buried in the ground too deep for immediate germination, retain vitality almost indefinitely, and the number of seeds which has been so buried in many of our soils is very great. Cultivation must be very long continued in order to permit the destruction

of all such seeds. Every time we plow we are likely to bring a fresh lot of seeds near enough to the surface to enable them to vegetate. Cultivation must therefore be persisted in for a good many years, or it will prove relatively unimportant in its influence on the number of weeds which will start when at length the field is seeded. Conditions are most unfavorable for the germination and establishment of weeds in mowings if they be seeded early in August, after thorough preparation of the soil. Moreover, during the interval between plowing, which should take place early in July, and seeding, early in August, most of the weed seeds which lie near enough to the surface to germinate will have started, and the repeated harrowings above advised will have resulted in the destruction of the young plants as they start. When, after this treatment and after the thorough enrichment advised above, grass and clover seeds are sown, they make a quick and vigorous start, and the weeds gain but little foothold.

On the grounds of the Experiment Station mowings reseeded in this way are far clearer from weeds to-day than other mowings which were broken up and cultivated for a couple of years and then reseeded. It would, of course, be possible to give fields which have been cultivated such treatment as has been recommended in the case of mowings broken and reseeded without cultivation: but this would involve a greater loss of time, and would not seem to have any especial advantage. In the case of weeds starting from perennial roots only, such, for example, as witch grass, does a period of cultivation appear to be essential.

Use Care in purchasing Grass Seeds.

The seeds of several of the most troublesome of the weeds in our mowings are commonly found in commercial samples of grass and clover seeds, and a great deal of care should be used in the purchase of such seeds to avoid samples containing the seeds of troublesome weeds in any considerable number. Among the weed seeds which seem to be most commonly mixed with commercial samples of grass and clover seeds are those of dock and sorrel, the yellow daisy, butter-

cup and plantain. Farmers may send samples of seeds to the Experiment Station for examination; but it would be a relatively simple matter for any farmer to collect a few seeds of these commoner and more troublesome weeds, and keep them for comparison with any foreign seeds which may be found in grass or clover seeds purchased. In this way, by the use of a magnifying glass of moderate power, the seeds of any of the weeds mentioned can be identified. By the exercise of care in the purchase of grass and clover seeds much trouble and expense may be saved.

The white daisy (*Chrysanthemum Leucanthemum*) may be practically eradicated from mowings without reseeding, by persistent early cutting, usually from June 12 to 15, and such enrichment of the soil as favors the growth of grasses. This plant is a biennial, and it is only necessary to prevent the ripening of seed.

The yellow daisy (*Rudbeckia hirta*) is not ordinarily troublesome save on light soils. Pulling the plants soon after they come into blossom will prove efficacious.

The wild carrot (*Daucus Carota*) is one of the most troublesome weeds in mowings, and has been allowed in many localities to ripen a tremendous amount of seed, so that the soil is thoroughly infested with it, and replowing will not be likely to prove effective. Timely cutting to prevent the ripening of the seed is a better preventative, and if persisted in for a few years the carrot will be eradicated.

Sorrel (*Rumex Acetosella*) is often prominent in new seeded mowings, but commonly disappears after one or two years. Its presence is an indication that the soil would be benefited by a liberal application of lime.

It seems to be impossible to procure grass and clover seeds entirely free from dock (*Rumex crispus*). The plants should be pulled after the stems become tough, but before the seed matures, which is best done after a rain, when the soil is soft. Hand-pulling is the method generally preferred, but there is no doubt that cutting the roots a couple of inches below the ground will destroy almost all plants.

Buttercups, common plantain, dandelions and ragged robin frequently become quite numerous in mowings, but are not

hard to keep in subjection. Liberal use of fertilizers will so strengthen the grasses and clovers that these weeds cannot become very prominent.

Horsetail (*Equisetum arvense*) sometimes becomes very abundant in mowings, usually in soils that are rather sandy in texture, but have at the same time a fair capacity for holding water. Mowings that are badly infested should be broken up and reseeded, with thorough cultivation before seeding, as its presence in mowings is sometimes a source of danger to horses fed with the hay, it exerting a distinctly injurious effect when consumed in quantity, and sometimes causing death.

HOW TO SUPPLEMENT A SHORT HAY CROP.

BY PROF. CHARLES S. PHELPS, SUPERINTENDENT GRASSLANDS FARMS, CHAPINVILLE, CONN.

Hay is so important a fodder in wintering all kinds of stock that the indications of a probable shortage in the crop are always looked upon with considerable apprehension. The indications as to the probable yield are not very strong, however, until the time is past in which some of the best substitutes can be planted. For example, spring-sown oats and peas make a most valuable hay, but this crop should not be sown later than May 15 in Massachusetts. Nevertheless, there are quite a number of substitutes for the first crop of hay, which may be planted in June or July, which will make valuable forage. But, before considering special crops as substitutes for hay, it will be well to consider methods of handling the first crop so as to provide for a heavy second growth.

It will generally be noticed, on fields where there is any clover, that in dry seasons the proportion of clover is greater than in wet seasons. This is probably due to the fact that clovers will withstand the effects of drouth better than our common grasses. Fields with much clover on them should be cut early, so as to get the most possible good from the clover, and let the grasses growing with it be of secondary importance. This early cutting will encourage a vigorous second growth of both the clover and the grasses. A large crop of rowen may often be thus obtained. In order to assure a strong second growth, it is wise to apply some quick-acting fertilizer soon after the first crop is removed. The writer has found that 150 pounds of nitrate of soda per

acre will give profitable returns in the second crop of hay. Most manufactured fertilizers which contain a large proportion of quick-acting forms of nitrogen should give good results when used in this way. Fine and well-rotted stable manure, while not as active as most chemical fertilizers, will often pay in the increase of rowen, when spread on the grass lands shortly after the first crop is removed.

Another method of obtaining a good second crop where it is desirable to keep the field in permanent mowing and the soil is badly "run down," so that very light yields are obtained, is to cut early and plow and seed at once to clover and mixed grasses, using at least 15 pounds of clover seed per acre. Where the seeding is done early in July, a good crop of clover should be obtained late in September or early in October, and a strong growth of grass and clover will follow for the next year.

In selecting crops for growing late in the summer and during the fall an effort should be made to grow those that will be substitutes for hay or for corn silage during the fall and early winter. Green fodders for late fall feeding are valuable, in place of the scanty pasturage common at this time; or, after the ground is frozen, field-cured corn fodder is nearly equal to silage or good hay. Dried corn fodder will generally be much better eaten and relished in the late fall or early winter than if kept till late in the winter, while the corn silage or hay will retain its full value through the winter.

CORN.

Of the annual forage crops adapted as substitutes for common hay, perhaps corn fodder is one of the best. Corn is a crop suited for growth on nearly all soils, and, with the many varieties to select from, kinds can be found that may be planted as late as July 10 that will give a fair growth of fodder. For late planting some of the large-sized sweet corns are the best. Frequently a good crop of sweet corn for the market may be had if the crop is planted early in July, while the fodder and smaller ears will be available as forage. This may be fed green, or, if damage from frost is expected, it may be dried and fed in place of hay.

Hungarian Grass and the Millets.

Of the annual crops adapted for hay, probably the Hungarian grass and the various kinds of millets are the best. The Hungarian grass makes a lighter and finer growth than the millets, and is to be preferred for hay; while the millets are better if green fodder is wanted. Hungarian grass tends to send up its blossom heads at an earlier stage of growth when sown late, and a shorter and lighter growth will usually be obtained if the seeding is deferred until after July 1. This can be overcome, in part, by having a well-fertilized or well-manured soil, with plenty of quick-acting nitrogen. Hungarian grass should always be cut early, even before all the heads are fully formed, as it rapidly becomes tough and woody after it passes the early blossoming stage. Of the millets, the Japanese and the golden millets are probably the best. These may be grown for hay, but make a rather coarse fodder. They should be grown on rich soil, and be seeded at the rate of not less than ½ bushel per acre. When grown thickly and cut before the heads are fully formed, the millets will make a fairly good grade of hay. Most dairymen, however, find them more valuable for green fodder than for hay. Even when used for green fodder, thick seeding and early cutting are desirable, in order to avoid the stems becoming woody, so that stock does not eat the fodder readily.

Soy Beans.

Soy bean fodder is a crop which has been strongly recommended for growing in New England, and it is worthy of careful trial. The writer has had fifteen years' experience with this crop in Connecticut, and has seldom had a failure. In years when corn can be grown to maturity, this crop will usually ripen its seed. If wanted for its seed, it should, of course, be sown early, not later than June 15; but for feeding green or for silage it may be sown as late as July 10. As this is a bean-like plant, it should be sown in drills and cultivated, and never be sown broadcast unless wanted for green manuring. One bushel of seed per acre has been found to be a good rate of seeding when growing the crop

for fodder. The seed may be planted in any of the common corn planters, or drills may be opened with a marker, and the seed be sown by hand and be covered with a plow or a wing-toothed cultivator. The crop may be harvested for silage, or be fed green. When used for silage it should be placed in the silo in layers with corn. Two loads of corn to one load of the soy beans makes a good mixture. Soy bean silage, when preserved alone and fed separately, has been known to cause a disagreeable flavor in milk and butter; but when the mixture of two-thirds corn and one-third soy beans has been fed in the form of silage, no bad results have been noticed. Soy bean fodder may be fed green for three to four weeks in September, providing frost does not injure it. No bad flavors are known to occur in milk or butter from the crop when fed in the green state. When used as a green fodder, the feeding should commence as soon as the crop begins to blossom, for the stems of the plants become woody soon after seed develops.

Poor success will often be had with this crop until the soil becomes inoculated with the special bacteria which produce the nodules on the roots of soy beans. This inoculation may be accomplished by treating the seed with the pure cultures now offered for sale by reliable dealers; by getting soil from an old soy bean field, where the nodules have been abundant on the roots of the crop; or by getting the dried nodules from the roots of a crop, and saving them over until another year. This last method may be carried out by pulling a part of the crop where the nodules are plentiful, and when the fodder is well dried, shaking the dirt and nodules adhering to the roots onto bran sacks, and then saving this material over winter for use in treating the seed for another crop. By mixing this dry material with the seed just before it is planted, the crop will become inoculated quite early in its growth, and more completely so than where soil inoculation is practised. The most common method, however, is to dig about 1,000 pounds of surface soil from an old soy bean field, and use it broadcast on the new field, harrowing it in before planting the seed.

Oats and Peas.

Oats and Canada field peas, which so many find valuable for summer feeding and for hay when sown early in the spring, may also be grown as a fall forage. This crop can be sown in July on fields where rye has been harvested, or after early-cut grass. The peas should be plowed under rather shallow, at the rate of 1½ bushels per acre, or else be deeply harrowed in with a wheel harrow; while the oats should be sown at the same rate, and be lightly harrowed in. This crop may be fed green, or in many seasons, when grown on rich soil, will make a valuable hay for harvesting early in October.

Barley and Peas.

Barley and peas is another forage crop valuable for fall feeding. It has advantages for late forage not possessed by oats and peas. While oats are damaged by heavy frosts, barley will remain vigorous and continue to grow until early in November. This makes the barley and peas valuable for late soiling purposes or for pasturing. The barley and peas should be sown at the rate of 1½ bushels of each per acre, and the crop may be sown as late as the first week in August. We have used this crop for soiling purposes as late as the middle of November. Some farmers have had poor success in growing the peas when sown in the summer. Where this is the case, the oats or the barley may be grown alone, and will produce good crops when seeded at the rate of 2½ or 3 bushels per acre.

Winter Vetch.

A valuable fall forage crop which may be grown for pasturage is winter vetch. This may be grown alone, or with winter wheat. This combination has been grown more commonly as an early spring soiling crop; but, if planted as early as July 20, a heavy growth of both wheat and vetch may be had for fall feeding. This crop makes a rich pasture feed, or it may be cut and fed as a soiling crop. If pastured and not fed very closely, enough will usually be left over winter to furnish feed for pasturing or soiling in the early

spring. The vetch seed is quite expensive; but, as the seeds are small, ½ bushel per acre will suffice for a good seeding, when used with 2 bushels per acre of wheat.

Rape.

Rape is a turnip-like plant, which often grows 3 to 4 feet tall. It is quite commonly grown in the more northerly countries of both Europe and America as a feed for sheep. This may also be grown as a late fall fodder for feeding to young stock or to dry cattle. We would not advise its use for dairy stock producing milk, unless in quite small quantities, because of the danger of producing a disagreeable flavor in the milk and butter.

Cabbage.

Late cabbage is a crop which can often be grown with profit by dairymen as a market crop, and the unmarketable portion will furnish valuable fodder. Retail milk dealers, with routes in the smaller cities or in towns and villages, may often find a ready retail market, at a good profit, among their customers for all the larger and better heads of cabbage, leaving only the poorer heads and the leaves as fodder; or cabbage can usually be shipped to the larger cities, and sold at wholesale, finding a ready market at a fair profit. This crop, however, may be an economical one to grow even when raised entirely for stock feeding. The plants may be set as late as the middle of July, and still make a heavy growth of firm heads. To get the best results, the soil should be made rich with well-rotted stable manure. Cabbage is not injured by heavy frosts, and that portion of the crop not fed before the ground freezes may be stored in piles, covered with leaves or straw, and be fed during the early winter.

Apples.

In seasons when there is a large crop of apples, these may be fed to advantage. The poorer kinds of fruit, and that which is not of a high enough grade to sell as market fruit, can often be fed to dairy stock with good results. Stock soon become accustomed to the fruit, so that the amount fed

may often be increased to 3 pecks or more per day, by starting with a peck per day. Apples should always be fed in the mangers rather than in the field, so that if choking occurs, the condition may be more readily discovered and relief afforded.

In some localities apple pomace may be regularly obtained from the cider mill, and this has been found to be valuable feed for milch cows. One of the most successful dairymen in Connecticut uses this feed regularly during the fall months. At first it was obtained for the hauling, but others soon perceived its value, and the demand became so strong that the price advanced to $1 per load.

This feeder considers it nearly equal in feeding value to corn silage. When silo space is available, apple pomace may be stored in the silo, making a valuable winter fodder. During the rush season at the mills it can often be obtained in larger amounts than the herd will consume from day to day, and if preserved in the silo, a supply may be provided for many weeks ahead.

Feeding the Hay.

When all has been done that can readily be done to supplement a short hay crop by growing substitutes on the farm, something may also be accomplished by exercising good judgment in feeding the hay. Many have the impression that milch stock should be fed all the coarse fodder they will eat. This we believe to be unnecessary, and contrary to the teaching of some of the more recent experimental work done by the experiment stations. The more palatable and the more easily digested the ration of a milch cow is, the better. To obtain the best results, about one-half of the dry matter of the ration should come from the grain feeds. This means that grain feeds should constitute a large part of the total feed of the cow. If a considerable part of the coarse fodder of the ration comes from the silage, only a small part need be provided in the form of hay. The cheaper dry fodders, such as corn stover or oat straw, may be fed in connection with liberal silage and grain feeding, and good results will follow.

Recent experimental inquiry has shown that the value of a feed depends quite largely on the ease with which it is digested. It was formerly supposed that a pound of digestible dry matter from one source was just as valuable as a pound from another, but this supposition has been overthrown by recent experimenting. The energy or labor required in digesting a certain feed must come from the food eaten. If the food eaten is largely coarse, dry fodders, more energy will be required in the work of digestion, and less will be left for building up valuable products, than where the feed is mainly easily digested materials, such as succulent fodders or ground grains. For the same reason, the older and tougher the fodder is when harvested, the greater will be the labor of digestion. Some German experiments have shown that from 10 to 12 per cent of the total energy of certain coarse, dry fodders was used up in the labor of digesting the fodder.

It may thus readily be seen that the extensive feeding of coarse, woody fodders is a severe tax on the total energy of the ration in the work of making the food nutrients available. It follows, then, that a ration made up largely of grains and ensilage and early-cut hays, with only a small proportion of coarse or late-cut dry fodders, will furnish a larger proportion of available energy than a ration composed quite largely of coarse, dry fodders. This helps to explain why the exclusive or heavy feeding of late-cut coarse fodders to milch cows is not generally profitable.

PRACTICAL POULTRY HOUSING.

BY JOHN H. ROBINSON, EDITOR OF "FARM-POULTRY," BOSTON, MASS.

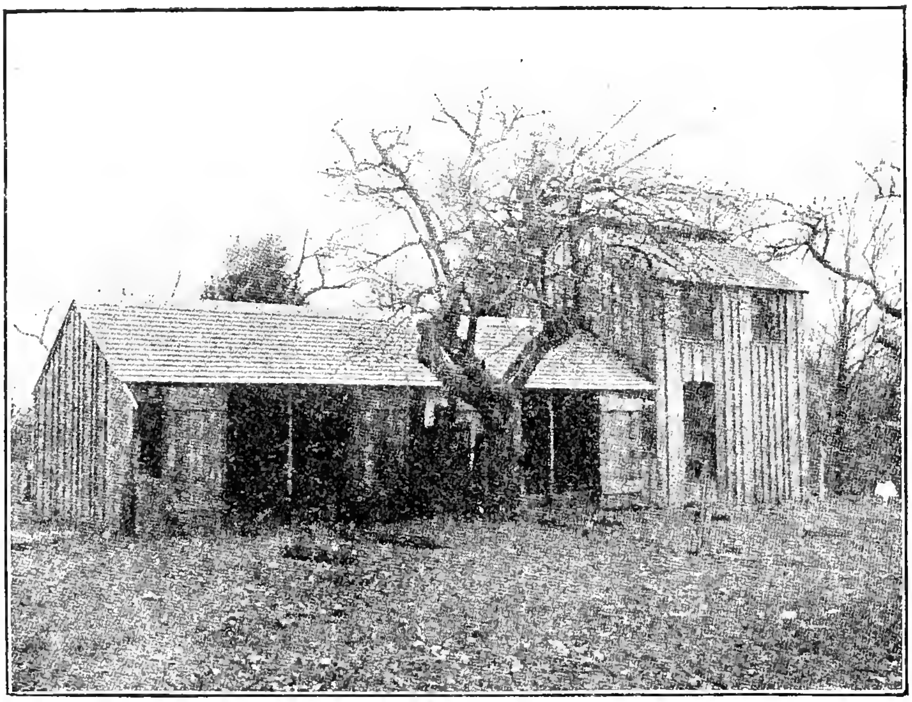
At several of the farmers' institutes in this State which it has been my privilege to address during the past year, the description of some poultry houses I am using and explanation of reasons for using them has excited enough interest to make me think farmers throughout the State may be equally interested in that subject.

The ideas and principles upon which this method of housing poultry is based are not new, nor are they at all novel. On the contrary, they are very old and very common. The noteworthy thing among them is that they have not until within a few years seemed to those looking for the best ways of housing poultry to be worth serious consideration. For several years now they have been much discussed in the poultry press, and the general interest in them and increasing tendency to use them marks what is probably the last stage in the reaction from the plans and methods most in favor since the interest in better results from poultry culture began to assume its present importance.

For a great many years authorities on poultry keeping have advocated warm, tightly built poultry houses. They have held that, inasmuch as hens naturally laid best during the spring, the essential thing (if one wanted to get eggs in winter) was to reproduce spring conditions, especially temperature. So, with double and triple walls, with dead air spaces, with double sash on the windows, with large windows to admit as much sunlight as possible by day and with roosting rooms and closets to shut the fowls up close and keep them warm in at night, they have tried to approximate spring conditions. In a degree they have succeeded, as far as temperature is concerned, — that is to say, they have suc-

ceeded in maintaining a higher temperature in the poultry houses than is usually found in out buildings for live stock. They have protected the fowls from the extremes of winter weather.

But the temperature is only a part of spring conditions. In spring and summer fowls have, with the higher tempera-

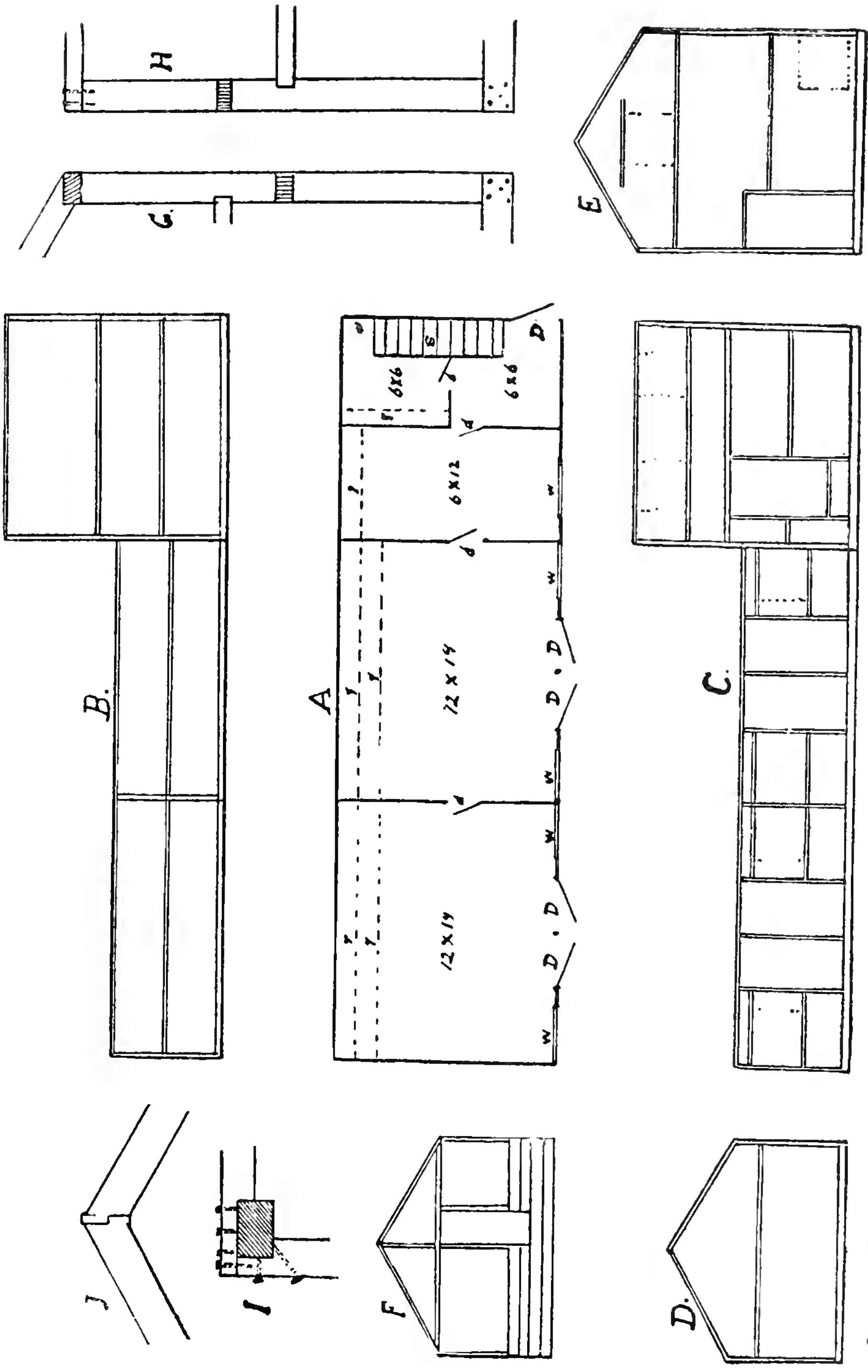


BUILDING USED IN J. H. ROBINSON'S FIRST COLD POULTRY HOUSE EXPERIMENT.

tures, abundance of air in the houses, and live much out doors. The out-door temperature and the temperature inside the house are not much different. In the house it is cooler on a very warm day and warmer on a cool day, but the difference would rarely exceed eight or ten degrees either way.

In winter, if the house is to be kept at a much higher temperature compared with the out-door atmosphere than at other seasons, the house must be shut up, and there must be no free and rapid circulation of air between the exterior and interior, except when the out-door temperature is high; for free circulation of air when the outer temperature is low will reduce the temperature in the house to within eight or ten degrees of the outside temperature, and if the outside temperature is zero, or ten, twenty or more degrees below, this makes the inside colder than, on the theory that the house should be kept warm, is advisable.

To keep the temperature in the house up as high as required by this theory of housing, the house must either be



PLAN OF POULTRY HOUSE USED IN J. H. ROBINSON'S FIRST COLD HOUSE EXPERIMENT.—This building consists of two parts,—a two-pen house 12 feet wide by 28 feet long, and a two-story part 12 feet square, with small pens on ground floor and room for pigeons, storage or other special use overhead. The low part is 6 feet high at the eaves, the other 12 feet. A, ground plan of house; DD, outside doors; dd, inside doors; ww, windows; rr, roosts; s, stair; B, outline of frame work of rear wall; C, outline of frame of front wall; the dotted lines indicate the position of the windows; D, outline of frame of west end; E, outline of frame of east end; F, an inside partition between pens; G, framing of west end at corner post; H, framing of back at corner post; I, framing of posts and sills at corner; J, method of roof construction at peak, explained in the text.

kept shut so close that the heat from the fowls keeps up the temperature, or must be heated artificially.

Artificial heating in houses for laying stock has been tried many times, but generally discarded as unsatisfactory, and

not giving returns to justify the expense. In central New York some of the large egg farmers who use S. C. White Leghorns to produce eggs for the New York city market keep stoves in their houses, but I know of nowhere else where it is generally done.

When a house is kept shut close enough to keep the temperature up by the heat from the fowls, proper ventilation becomes at times impossible. Under some conditions the house cannot be kept warm with the heat from this source, and at the same time the air in it renewed as often as it should be. When only the nights are cold, or occasionally there is a day so cool that it is thought best to keep the house shut up, no serious bad results develop. But when there are several days of continued cold weather, with the houses shut all the time, conditions inside the houses begin to be bad; and if — as sometimes happens — cold and stormy weather is prolonged for a week or more, conditions in the poultry house become very bad, the walls and under side of the roof drip with moisture, and the air becomes bad. Under such conditions roup often develops and becomes epidemic; or, where no virulent disease appears, the fowls are catarrhal, debilitated and unproductive.

It is often said that roup and kindred diseases were rare in old times, when most of the stock in the country was mongrel or old barnyard stock, and when all the attention the average poultryman gave to selection for breeding was to swap roosters every year; and many attribute the trouble to in-breeding, and to a greater liability to disease in thoroughbred fowls. I think it is due more to other causes, and as much to tight, badly ventilated houses as to any other cause, or perhaps to all other causes combined. Certain it is that in a great many instances in the last few years opening up the poultry houses and giving the fowls pure air in abundance by night as well as by day has been followed by a marked improvement in the general health of the flock.

My own experimenting with cold and open houses was undertaken to show what was possible under conditions quite the opposite of those generally recommended as necessary

to good egg production and healthy stock in winter. I was constantly receiving inquiries from poultrymen having trouble with damp houses as to how to remedy that condition; and, as I visited poultry plants in winter, I almost always found the houses damp, badly ventilated, and overheated about midday even of quite cold days.

I think that in most cases conditions need not have been bad had the poultrymen used ordinary judgment in opening doors and windows. The common practice was to keep houses closed in winter except on very bright, warm days, and then open them either only for a little while in the middle of the day, or open them toward midday and leave them open until dark. Very often it would happen that houses were kept closed tight all day on a bright day, when the sun shone warm during the middle of the day and made the poultry house as warm as a green-house. Frequently the poultryman kept doors and windows shut nearly all the time, relying upon his ventilators to supply fresh air. That the ventilation did not work as theoretically as it was supposed to work was generally plain to any one who stepped into the house, — except the owner. Where the intention was to ventilate by means of doors and windows, opening the house up gradually in the morning and gradually closing it in the afternoon, the system rarely operated as planned. Such a plan, if faithfully put in practice, works well except for long-continued cold weather, when the short time the house may be opened is not long enough to thoroughly air and dry it; but I have seen very few plants on which this plan of ventilation was operated as it should be. On most plants it is attended to very irregularly, and often neglected for days while the poultryman's time is taken up with matters which seem of more pressing importance. Such a system of ventilating requires more time and attention than many poultrymen are able to give it; hence, is not for them a satisfactory system.

There was no guess-work or theory about my opinion that most poultry keepers would not give the ventilation of tight houses the attention necessary to make them satisfactory. Almost everywhere I went in winter I saw it, and found

also that the worse conditions became in tight houses, the more afraid were the owners to let the air into them.

Various ways of preventing dampness in a tight house have been devised. Thick walls, double or triple, with air spaces or linings between, will not frost inside in cold weather as the single walls do. Some poultrymen make a loft of the space under the roof above the plates, and fill or partly fill it with hay or straw, which will absorb the moisture and keep the room dry.

Such devices, however, do not solve the problem of fresh air. It is practically impossible to keep a poultry house shut up so that the heat from the hens will keep it warm, and at the same time have the air in it renewed as it should be. If the building is large in proportion to the number of fowls kept in it, the heat from them has no appreciable effect on the temperature of it. If it is small enough to be kept warm by as many fowls as its floor space will accommodate, the air in it soon becomes vitiated. As I had occasion to look at the subjects of warmth and ventilation in the light of the experience of many different people, I began to think perhaps the prevailing ideas on those matters were not correct, and to ask myself whether it were not possible to get better conditions and satisfactory results in houses of a different kind.

To this question I found an answer that satisfied me in the large number of instances I could collect from memory, where as good results had been obtained in cold, poorly built houses as the average results in warm houses, and in the few instances where exceptionally good results had been obtained under conditions that we had been accustomed to regard as very bad. Such occurrences had, of course, been considered in the forming of the general authoritative opinion as to the requirements of winter poultry keeping, but were usually considered as exceptions that proved the rule, — a very convenient way of getting around facts that do not accord with theories.

But, however convincing the evidence a man may gather in this way may be to himself, it has not much weight with others; so, instead of publishing the results of my thoughts,

I went to work, built a house that in several important features was quite contrary to the prevailing ideas of what a poultry house should be, and used it for nearly a year before saying anything publicly about it.

This house was a mere shell or shed; the walls were of common hemlock boards, laid perpendicularly on a light frame, and the joints between the boards covered on the back and ends of the house with common battens; the joints on the front were left open. The roof was of shingles, laid on strips of furring placed three inches apart.

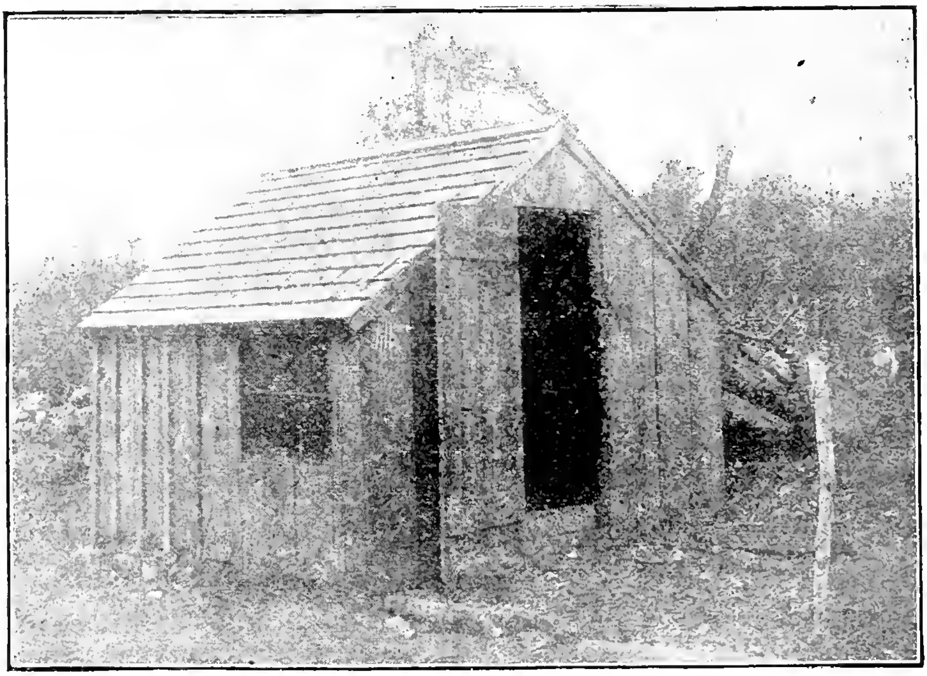
The house was not tight anywhere. As I used it the first winter, — it having been built in a hurry late in the fall, — the battens were merely held in place with two or three small nails in each, and were loose enough to let a great deal of air in around them. The cracks in the boards, some quite large, were not covered at all. The front of the house had double doors six feet wide in each section, and these were kept open all day unless a storm would beat in, and all night except on very coldest nights or nights when storms would drive into the doors.

The house was built on wet ground, — that is, ground that was thoroughly soaked by the late rains. After the roof was on, the ground in the house was spaded up: and when the house, a few days later, was ready to put the fowls in, the surface of the ground in it was dry, but a mere scratching of it would show damp earth. By spring there was about two inches of dry earth on top, and the soil damp below that. The walls in the house were dry, — never a bit of moisture on them except as a driving rain might wet through the joints and cracks. This would dry out quickly, and I never noticed any ill effects from it.

The house was cold, — the temperature in it was but little higher at any time than that out doors; yet going into it I noticed that it always felt comfortable, with a feeling like what you get in a warm, sheltered spot out doors, — not at all like the warmth of a heated building.

The hens always seemed as comfortable in it as I ever saw hens anywhere. There were some fifty to sixty in it that winter, and only two slight cases of colds, which recovered

immediately with no treatment but a single application of vaseline to the head. The egg yield was fair, comparing favorably with average good reports. The hens in this house were Light Brahmas. I published a report of experi-



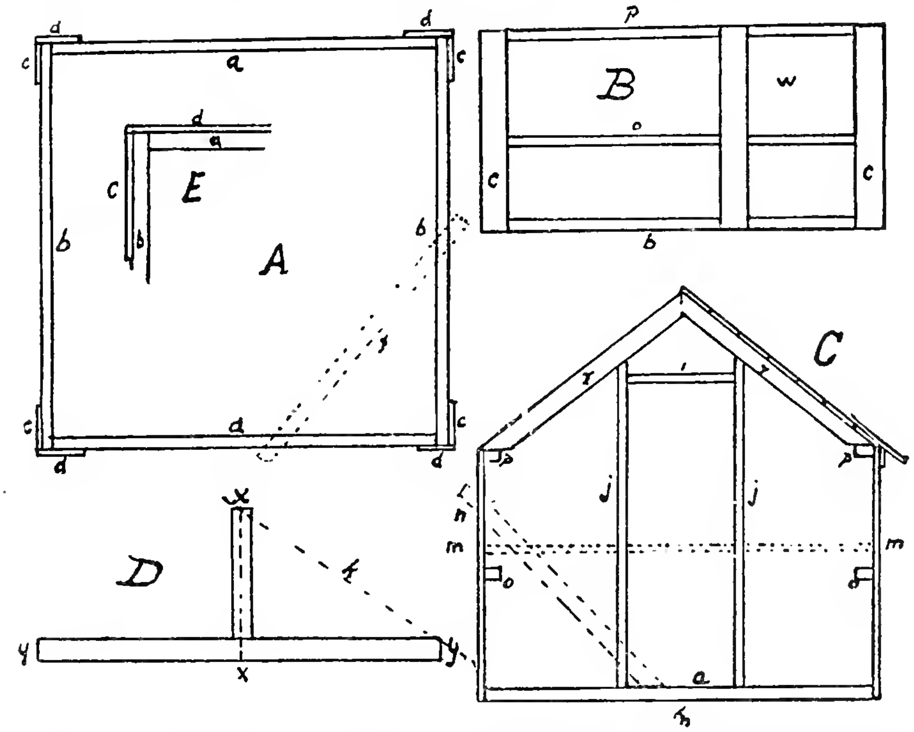
HOUSE IN WHICH LIGHT BRAHMA PULLETS WERE KEPT.

ence with this house, and on the strength of my experience with it began to urge correspondents who had much trouble with damp houses or unhealthy fowls to open up their houses, and keep them open at all seasons.

The next year I continued to use this house the same way, but put in a part of it a pen of Silver Dorkings, a breed reputed to be rather delicate and susceptible to cold, and having combs which would be more quickly affected by the frost. I also built another smaller house, on the same principle, and put in it a brood of late-hatched Brahma chickens. The Dorking male had his comb very badly frozen, but the hens' combs were scarcely nipped at all. They were put into the house December 1, began to lay in about three weeks, and laid well all winter.

The brood of chickens hatched June 27 that I put in the small house in October made a remarkable record for growth and early maturity. I got the first egg January 15, and by February 1 all the pullets, nine in number, were laying;

and from that time until February 22, when I took some out to put in my breeding pen, the nine pullets were giving me about a fifty per cent egg yield, and still growing. I weighed them all on February 22, and found five of the nine



DETAILS OF CONSTRUCTION OF HOUSE SHOWN ON P. 398.—This house is 8 feet square on the ground, 4 feet high at sides, 7 feet in the middle. Cost about $12. A, sill plan, with position of corner boards indicated at c c c c, d d d d; E, construction of a corner; B, side; C, front; D, method of cutting pattern for rafters.

weighing nine and one-half pounds or over, and none of the others much below it. These pullets were not fat; they were big pullets, in good condition. Their house, as shown in one of the illustrations accompanying this article, was battened only on the back and half way forward on each side. The door was open practically all the time, day and night; and the windows were always partly open except when a storm came against one, when that one would be closed.

The next winter, still continuing to use the houses I had already built, I built on frozen ground late in November a house very similar to that in which the Brahma pullets just mentioned had been kept. It was made of old material, and was a little poorer in construction all around than the other house, joints between sides and roof not as good, and some very wide joints between boards in front. Into this house I put my Dorking hens and pullets. This winter, 1903–04,

was, as all know, a record-breaker for cold and snow. Frequently after a night of driving storm I would go to this house and find so much snow sifted through the joints at the back that there was a light sprinkle of it all over the litter on the floor, — so much that the hens would not come down from the roost until the litter had been shaken up; and the backs of the hens as they sat on the roosts were well coated with snow. The tips of the hens' combs were somewhat frosted (no male was put in the house), but these hens gave me about a forty per cent egg yield in January, 1904. There were very few hens in any kind of house anywhere doing better at that time.

During the several winters covered by the experiments mentioned my fowls were cared for by myself when at home, at other times by different members of the household, none of whom had any particular interest in or skill in feeding fowls. Our one rule for feeding was to be sure that the hens had an abundance. In the first half of the winter I had to be away so much that I found it impossible to keep accurate egg records. When I relied on others, they forgot: and so I gave up thought of making statistical figures complete, concluding that circumstances limited me to general demonstrations of a few leading facts, and the exact results possible in cold houses and comparison of these with results in other houses would have to be left to others. My trials demonstrated that hens could be kept healthy and giving average good egg yields in cold, open houses. So far as I could judge, they consumed no more food than when kept in warm houses, though theoretically it should have required more.

Last winter the only item of experience in my poultry yard having a further bearing on this subject was the performance of a pen of July-hatched Single-combed White Orpingtons. These were put in an old poultry house that was sheathed, papered and covered with common lapped siding on the sides and with shingles on the roof. The front of this house was about half glass, an immovable window, and there was a half-window in each end, the door being at the north-west corner. The growth of an apple tree near the house had forced a board from the front next the roof,

and there was an opening here the length of the house wide enough "to throw a cat through." The west window was wide open all winter. The pullets in this house had been sold early in January, and, as I was expecting to ship them any day, we kept no record of their laying. The buyer failed to take them; but, as I still intended to let them go, and as some weeks had passed with no records kept, we let them go along unrecorded. Through January, February and March these pullets, nine in number, laid rarely less than seven eggs a day, and often nine for several days in succession. Nearly all their combs were somewhat frosted, and the comb of the male at one time quite badly frosted.

Now, of what use was it to demonstrate that warm houses are not essential to egg production, and that hens can be kept healthy and productive in very cold houses?

I went to the extreme, giving my fowls houses that were mere shelters, to show more convincingly, by extreme illustrations, that warm houses, which are more expensive to construct and require more careful attention to operate, were not absolutely essential. My tests, though not furnishing statistics, do show conclusively that egg production is not necessarily dependent upon "spring" conditions; and that the cold, open house for poultry is the style of house in which the labor of caring for them can be reduced to the minimum. Considered in connection with the general difficulties with tight buildings, they indicate also that the safest and most profitable and practical type of house for most poultry keepers is the house that is so constructed that it does not require close attention from the poultry keeper to keep conditions in it safe. They have not developed what is the best construction of house. It is reasonable to assume that a little better construction than I have used would be better, — would afford more protection, without making conditions that interfere with the steady renewal, in abundance, of supplies of fresh air.

Between the house so tightly built that the ventilation in it is very bad, and one so open that the temperature in it is but slightly higher than out doors in extremest cold weather, there is a medium form of construction and an intermediate

in methods of operation, which will give more protection in the house without reducing too much the circulation of air in it. I think this medium form of construction must be much nearer the cold than the warm plan of housing; for when air is admitted freely, as it should be, the house cannot be kept very warm: and when the house cannot be kept warm, it is superfluous to make walls thick, and adds unnecessarily to the cost of construction. A wall of inch boards covered with a good building paper is as tight as if it were a foot thick. If a house is built with tight back, ends and roof, and has wide doors and good-sized windows in front, and doors and windows are kept open as much as is necessary to prevent moisture from collecting on the walls and lower side of roof, the air will be good in that house, and the fowls healthy as far as health depends on good air. In a cold climate, such a house will be cold, — not as cold as outside, but still a cold house.

The special interest farmers have in this plan of housing fowls is in the demonstration it makes of the fact that there may be good egg production in a cold house; and that one need not despair of getting eggs in winter because his poultry houses are cold, or think that when he fails to get eggs in winter it is because his houses are cold. On most farms at present the poultry houses are of the class of those I use; and I find a great many farmers have been under the impression that it was useless to put forth special efforts to get winter eggs from poultry in such houses. The fact is that the house is not a matter of prime importance, except that in a warm, tight house that is kept shut up too much the hens are more likely to go out of condition and fail to lay than in a cold house; and, again, hens that do lay well in a warm house are apt to become debilitated and weak, and unfit for future usefulness either as layers or breeders.

The thing of first importance in the production of winter eggs is to have the fowls ready to lay about the beginning of winter; after that, the point of greatest importance is to feed well. These are the things without which you cannot get eggs until they are full grown. Old hens do not lay profitably until they have molted. Both pullets and hens in laying

condition must have food enough to maintain themselves, and enough more to convert into eggs. In the spring a hen may produce eggs at the expense of her maintenance, but in fall and early winter she will not, as a rule.

The principle which the possibility of good results in cold houses and the successes and difficulties with hens in warm houses combine to establish is this: given hens in laying condition, and abundance of proper food, egg production depends on uniformity of conditions more than on high temperature.

Such uniformity of conditions is more easily secured in a house that is not much different in temperature from the outside air than in one that is kept much warmer than the outer air in extreme cold weather. In the open house the variations of temperature are less than in the house that is kept warm in coldest weather, unless the ventilation of the warm house is looked after much more closely than is customary. The open house does not need close attention. The fowls in it are hardened, — accustomed to a lower range of temperature than those in warm houses. Because of this, and because, breathing always pure air, their vitality and capacity to stand changes in the weather are greater, they are less affected by weather changes than fowls in closed houses.

To their better circulation and greater vitality also I attribute greater perfection in bodily functions, as seen in the greater fertility of the eggs from such fowls, and in the apparent fact that they get more nutriment from the food they eat. As I said a little while ago, I could never see that the fowls in the cold houses took any more food than fowls in warm houses. Since I began the experiments mentioned in this article a great many have been making observations along the same line, some independently of and without knowledge of what I was doing, and others because of the interest discussion of my tests excited. The general verdict of these is that no more food is consumed in the cold houses. Some say the fowls in the cold houses seem to eat less; a few affirm that they do eat less. Such statements seem at first thought improbable, yet they are not, on consideration, wholly unreasonable.

It is a fact which any one who has the opportunity and cares to take the trouble can easily demonstrate for himself, that dwarfed and stunted chickens eat as much as well-growing, hearty chickens of the same lots, yet hardly show any increase in size, while the others are growing rapidly. Long after the thrifty chickens have grown out of all comparison with the runts, if you separate them you may find the little runts eating much more in proportion to their size and rate of growth than the others, and often eating actually as much as the others. Why is it? Simply because digestion and assimilation are imperfect. The chick is ill nourished, not because it does not get enough or the proper variety of food, but because its system does not do its work properly. Much of its food passes through it undigested. So with the fowl which breathes impure air. Its functions are sluggish. Its circulation is poor, as often shown in the chilled comb and the general air of listlessness. It is reasonable to suppose that digestion, too, is impaired, and the fowl gets less nourishment from a given quantity of food than it would if all functions of the body were in a higher state of activity. From this point of view, the observation that hens eat no more, and may eat less, in cold houses, seems worthy of some credit: and it begins to be doubtful whether there is actually, as theoretically there has been, an economy of food in using warm houses.

The strongest point that can be brought against the cold house for poultry is that it is not suitable for fowls with large combs and wattles easily affected by frost. This point has not so much weight with farmers in this State as in places where Leghorn and Minorca fowls are kept, because white eggs are wanted. Here most of the fowls on the farms are Plymouth Rocks, Wyandottes or Rhode Island Reds. The combs of the hens of these breeds are not easily affected by frost. Many of the male birds are almost as easily frosted as Leghorns. Where only a few males are needed they can be removed to warmer quarters on very cold nights; but with birds not intended for exhibition, or for sale for purposes where a frosted comb would count against them, I would let the comb freeze and the bird lose a part of it. It

seems a cruel way, yet on the whole is more merciful: for, if the bird is properly taken care of after the comb is frosted, it does not seem to suffer much, the comb soon heals, the frosted tips drop off, and the bird is thereafter practically immune from frost bite, and the keeper does not have to give it special care.

I make the foregoing suggestion to those who have male birds with moderately large combs, and want to use cold houses. I would not advise it for fowls with very large combs, which if exposed would lose most of the comb. The best way is to keep fowls with small combs not easily frosted, or if one thinks he must have large-combed fowls, to select for breeders those least susceptible to frost. There is a great difference in individual birds in this respect. I have had Leghorn males with very large combs that were never frosted, though repeatedly exposed to temperatures at which other Leghorn males and many males with smaller combs were quite badly frostbitten. A few people using cold houses for Leghorns report that their Leghorns that have been all their lives kept in such houses do not suffer as much from frosted combs as the same stock in closed houses. While I would not deny that they may be correct, it seems to me that conditions with them must be more moderate than in this section, or the houses were not as open as those I have been describing. As a matter of fact, large-combed males are a deal of trouble where the winters are cold, no matter what kind of a house is used; and practical poultry keepers, whether on farms or elsewhere, will find it to their advantage to breed for small combs. There is, I know, a very general belief that the largest combed hens are the best layers and the largest combed males the most vigorous sexually, and hence the most useful as breeders; but I think this impression erroneous. The best-laying Barred Rocks I ever owned had combs so small that the development of the comb as the pullets began to lay was often not noticeable. In Leghorns I have never found the size of the comb at all reliable as an index of laying capacity; my good layers of that breed have had large, medium and small combs, and I have found all degrees of productiveness in all kinds of comb

but one. There is a type of comb most conspicuous in Leghorns and other large-combed fowls, but found in all classes of fowls but those having very small combs, that I believe is a sure index of lack of vitality. This is the undeveloped comb that goes with a peaked-looking head on a poorly developed bird. It is small to medium in size, and shrivelled in appearance. The small comb that still appears to be fully developed is the ideal comb for the fowls of the practical poultryman; and if he breeds for such combs on his fowls and for general hardiness, he will soon have stock of which both males and females are adapted to the cold house in practice.

I have gone thus at length into this matter of size of comb, because the fact that in a cold house in this climate the temperature will go lower than is safe for most large-combed males is the one serious objection to cold houses. The other objections cannot be maintained against a test, but the cold house is not a house for a male with an easily frosted comb.

The characteristic feature of the cold, thoroughly ventilated poultry house is not so much in the method of construction as in operation. By opening doors and windows, any house can be made a cold poultry house. A good many houses built for warmth are now being used as cold houses. If the owners had to build over again, they would build less expensively; for there is no need of making special efforts to have a building very warm, when the windows are to be always open.

The cold poultry house may be of almost any design or style desired, except that ventilation should be from the front of the house and the roosts at the rear; for the philosophy of cold housing is not to expose the fowls, as much as possible, but to strike the degree of protection which is sufficient for the fowls and least trouble to the keeper.

With this article I give the plans of the houses I have described. These are houses that suit me for flocks of the numbers kept in each, and houses well adapted to farm poultry keeping. The small house, if made with close-fitting joints on the back and half way forward on the sides, is warm enough for the breed I keep, or for hens of the American

breeds, Plymouth Rocks, Wyandottes and Rhode Island Reds. The larger house, unless in a very sheltered location, is better to be tight everywhere but in front, for it is a higher house, and the heat from the hens makes less impression in it. In the small house the heat from a dozen large hens has a very perceptible effect on the temperature, even in zero weather.

In conclusion, let me briefly enumerate the advantages of cold houses: —

1. Economy of construction.

2. Economy of time and relief from close attention to ventilation.

3. Healthier fowls.

The foregoing are the positive advantages. As to results, we may say: —

1. That, as a rule, the production of eggs will not be as good as in warm houses that are carefully operated, but will be better than in warm houses as commonly operated.

2. That whether the difference in egg production in a warm house can be made enough greater to pay for the better attention and the greater risks of disease as a result of any little slip in the system, is a question for each individual to determine for himself. Most farmers would determine in favor of the cold house, because it leaves them more free to look after other work.

A Final Caution.

The cold house, though it has advantages, is but a part of a system. I have made the point that the kind of house is not a matter of prime importance; that the essential things in the production of winter eggs were: —

1. To have pullets and hens ready to lay at the beginning of winter.

2. To feed them well.

The argument for the cold house rests on the proposition that uniformity of temperature and dryness in the house are the most favorable conditions for health and egg production, and that these are more surely secured by most people in cold houses than in warm ones.

The cold house is simply a condition for the hens, and a convenience for the poultry keeper.

COMMERCIAL PORK MAKING AND PIG RAISING IN NEW ENGLAND.

BY A. A. SOUTHWICK, FARM SUPERINTENDENT, STATE INSANE ASYLUM, TAUNTON, MASS.

The question might be asked why we should engage in this industry in Massachusetts and New England generally, and the only answer can be, because there is an unlimited demand for the products of this immense and growing industry. Another reason is that our climate seems to be an ideal one for the thrift and general health of this class of animals. Again, I am most happy to say that we have right here the best grain-growing location in the world. True, many will say the hired help problem must be solved before we can branch out very much in carrying out an idea which would probably be considered an experiment with most farmers. To the doubting minds we would say, make a beginning, and the problem will solve itself.

Breed.

The question of breed is certainly an important one, because upon this, in many instances, will depend the value of the output. In a general way, a class of animals never should be chosen just because of the fancy of the owner. In every instance cater to the tastes of your patrons, because it is through them that your bank account will increase.

The hog, throughout the west, is universally termed the mortgage lifter; and the *lard hog*, so called, is most easily produced by the hundreds of thousands; but the bacon hog, the animal that produces the high-priced meat for our rapidly growing and fastidious population, is there a minus quantity. This being the case, there is every reason, and

the best reason, for leaving out the lard hog in our experiment of meat production here in the east. I do not hesitate to say that the Yorkshire is pre-eminently the hog for the east, because of the unexcelled quality of bacon and hams produced. My own choice of breeds would be the Berkshire, at once equal to any as a pasture hog, equal to the best, perhaps, for the fine quality of bacon and ham produced. And this animal is a pretty good lard hog, broad, and with thick pork on the back when well fed. The only objection, which is in reality no objection at all, is the color, which is black. No one ever heard a customer object to the color of a white hog, but this cannot be said of the black ones. So I say, once again, in the selection of breeds choose the one that your customers demand.

We all have our likes and dislikes, — that is human nature; and so for this reason it is no use to expect that every farmer, although he may have all the requirements to perfection so far as location and surroundings are concerned, will engage in hog raising, because his interest is not in that direction; and I would say, in all honesty, if one is not interested, do not engage in this business, because failure will be most sure to follow.

This business and the dairy should always go together, because, as the feed question is a very important one, milk from the cow, when possible, will produce that high quality and thrifty condition so much to be desired in the young pig when he is about ready to be put on sale, at the age of from six to eight weeks. The high price and demand for cream is in itself sufficient inducement for keeping the cows.

Care.

The summer care of hogs is a comparatively easy problem, but it is, according as one is situated, not quite so easy in winter. Pasture and pure water are the perfection of feed for summer; and for winter, nice, succulent sugar beets, raw, early cut rowen and good fresh water, with a little warm slop of boiled-up turnips, cabbage or squash and a little skimmed milk, are just right for the breeding sows, small pigs and growing shotes, with a little addition of corn

and ground grain, as barley, oats and corn, and a little of the best quality of wheat bran, for the pigs that are nearing the dressing-off period. Some two or three weeks before killing time, eliminate turnips, cabbage and squash from the ration.

There is sale for small pigs in every neighborhood, especially in spring, and these pay the best of any part of the business; but the left-overs will go to pasture, and will turn most acceptably in the fall. Many a farmer will say, To what extent shall I go into this new departure? And to such I would say, Plan to have a carload on hand after supplying your neighbors with small pigs. After knowing how the business goes, then plan accordingly. A carload, one deck, is from fifty to fifty-five pigs, that will dress from one hundred and fifty to two hundred pounds each. Three acres of grass — not old, dried-up stubble — and an acre of rape will feed a carload of pigs throughout the season. Any of the good English grasses are all right, though clover is par excellence, if possible. Grass four inches high is perfect, and it should not be allowed to get beyond this. If the season is perfect and the growth rapid, turn in extra stock to keep it down, and remove when fed off sufficiently. If short periods of drought come on, try to irrigate, if possible. The acre of rape should be at one side, and divided so the pigs can feed off the two halves alternately once in about ten days. This must be left out of the feed some three weeks before killing time. Mud holes and wallows must not be allowed in the pasture, but a trough of clear, running water, and a shallow tank of water set on a plank platform, into which the pigs can step easily and cool off, are indispensable. This arrangement should be beside a fence, where the waste water can escape. Every pig that goes to pasture must have a ring in his nose, then the perfect pasture will be preserved during the season. An exception to this might be useful where a wood lot has been cut off, and it is desirable to bring the land into tillage. A hundred eight-weeks-old pigs, well cared for, will fix this piece of stump land in an incredibly short space of time.

Shelter.

An important item is shelter, and this must be perfect and very comfortable under foot. Clean, white sand is all right for bedding until the weather gets cold, then add straw. This shelter is best arranged along a fence. Allow the single roof to pitch towards the fence, so the eaves water cannot contribute towards making a mud hole under foot. This shelter is very inexpensive, and is constructed by setting good posts in the ground every ten feet, eight feet away from the fence. Let the fence be the height for the plate on the back side, and saw the posts off on the front line two feet higher than the back. Spike on the plates, and fit in one midway between the front and back so the roof will have a good support in the middle. Almost every enterprising farmer cuts some lumber from his place during the winter, and he would scarcely miss that used in this simple structure. I like to have the boards good length, — eleven or twelve feet is none too much, so there will be a good projection front and back. Double board, breaking joints carefully. As fast as nailed on, paint with some colored paint, to your taste. Use lead and oil, and you will be pleased at the nicely preserved roof. Fifty hogs in a bunch is enough in this part of the country, and all arrangements should be for accommodating this number. A shelter seventy feet long will be satisfactory. Do not let the material under foot become unsanitary, and be sure to safeguard against disease.

Something in the way of slop will be fed from day to day, as such material accumulates about the place, and so troughs must be provided. These can be preferably of cast iron, though good ones can be made of two-inch plank. Make a platform some sixty feet long and eight feet wide flat on the ground, as level as possible, of two-inch plank, leaving an inch space between each plank, and fasten the row of troughs along the middle; this will last for years if covered with some two feet of old hay every fall, after the hogs have been disposed of. Do not feel obliged to feed these hogs unless convenient, and you have the offal to dispose of.

Influence of Heredity.

In the pig business heredity plays an important part, very much more so than the majority of farmers are aware of; and perhaps the best and most valuable example of this is noticed in the disposition of the brood sow. The quality of good nature is just as certainly and accurately transmitted to the offspring as are the valuable qualities of the horse transmitted to the young colt. It is an impossibility, in a large herd, to have every sow good-natured at farrowing time; but it is easy enough to have the cases of bad temper so far apart that any occurrence of this kind is not worth mentioning. There may be extenuating circumstances that might cause a valuable sow to behave unbecomingly, but this should not be sufficient reason for discarding her or her pigs for breeders. If a sow is cross two litters in succession, dispose of her without hesitation, and do not retain any of her pigs for breeders. The perfect mother bunches her brood in a remote corner of the pen, and settles herself some feet from them. Prize such litters highly, and save every pig for breeders, especially if they are good ones. Hardly a day passes without some seeker after knowledge asks the question, How long do you keep both sows and boars for breeders? And I invariably answer, As long as they do well. We have a pair of thoroughbred Yorkshires that have produced five hundred dollars' worth of pigs since we have had them; and the remarkable thing about it is, that they never have produced a poor one. They are five years old, and I think the last litter, which we now have on hand, is the best of any yet. It is easier to raise ten good sows than one good boar, and we meet a great many farmers who understand this. Select this animal from a litter whose ancestors are noted for the good qualities that should be combined in the perfect hog. Look for one that is as good over the hips as over the shoulders. You will not find this kind plentiful. Object to a coarse, heavy head in the young boar, but a different appearance is admissible in the aged animal. For myself, I do not object at all to some length of nose, provided that member is fine; my main idea being that a good,

well-developed and rounded body behind that nose is of very much higher importance. The boar is fit for service at eight months old, and the sow can produce her first litter at twelve months old.

Diseases.

The diseases which trouble the pig grower are comparatively few, and he can be reasonably safe from loss by keeping close watch of sanitary conditions. Do not compel the pigs to lie in wet, muddy nests over night; and never let an animal get chilled, because pneumonia is just as likely to attack the pig as the human subject, and, although the case is quite liable to recover, it is an unfavorable state of things, and not wanted. The most to be dreaded of all the diseases is swine plague or hog cholera. First of all, do not allow any one to come about your premises who has been where this exists. When it occurs, if the animals are in pens, wash the sides and floor with a saturated solution of sulfate of iron, and fumigate thoroughly every day with burning tar and brimstone. The fumes will not affect the animals, as the smudge will not be likely to settle in the pens. Feed charred corn, plenty of charcoal, and keep a fresh supply of coal ashes in the pens or pasture all the time. With reasonable care, disease of any kind need not be feared very much.

Small pigs at three weeks old or thereabouts are sometimes affected with looseness of the bowels. This is a natural condition with all young creatures, and, so far as I can see, does no harm unless the trouble finally affects the physical condition of the young creature. The cause of this unfavorable feature is easily noticed as due to a variety of causes. The presence of some foreign substance very unfavorably affects the delicate mucous lining of the intestines, and the resultant inflammation appears in the disagreeable looseness of the bowels. This condition causes more or less fever, and the young things will be noticed sipping the filthy liquid about the pen. Also they will root about the walls for any old, filthy, dried-on material that they can find to swallow. Fortunately, this condition does not last very long; and, if the surroundings can be immediately changed to the

fresh, sanitary conditions necessary, not much loss will result. If the sow cannot be moved to a perfectly clean pen, wash the old quarters perfectly clean, and keep them so for a few days. At any rate do not allow the young pigs to drink or take any filthy matter into the stomach. Keep constantly fresh sod and fresh coal ashes in such pens. Occasionally a sow is too milky, and the young pigs get overfed; but this seems to do little harm in the long run. The best condition that can possibly come to these young pigs is to get them out in the open air and sunlight, and on the fresh ground. It may be considered that unusual space has been given to this portion of the subject; but if one can judge from the frequency of complaints so far this season, this poor condition of the small pigs is a very serious one.

Show Animals and Thoroughbreds.

The finest pigs, in fact, the show animals, are raised during the summer, giving them free access to as much variety of range as possible; furnishing them with a trough by themselves, where they can consume plenty of milky swill; and every morning early treat them to six quarts of old corn to every hundred pigs. Customers will not complain at the price of these pigs, whatever that may be.

The breeding of thoroughbreds is a business by itself, and should not be undertaken by any one who cannot be strictly honest in keeping his records straight, and who is not willing to go outside for fresh stock every little while. It is scientific work, and requires keen judgment to decide what really constitutes a first-class animal. One must be an expert in order to mate up the Berkshires to get the most satisfactory results. It has been some twenty-five years since my own experience with the breed, and I am truly sorry to see so many coarse heads among some of the highest-priced animals. The subject of crossing breeds should not be ignored, because many a neighborhood is well stocked with good ordinary hogs, which can produce very satisfactory and paying results by simply introducing a thoroughbred boar of high individual excellence. The most sensible course to be followed would be to use the stock as it is found in a neighborhood, and gradually introduce a better foundation.

Marketing.

The question of marketing is an important one. Every neighborhood, village and even large cities contain families who salt down their yearly supply of pig pork as surely as the year comes around. This class of custom pays the best of any, and can be secured by a little advertising; and if a good, neat article is always forthcoming, this trade can be kept for a lifetime. All who engage in this business will not care to sell in a small way here and there, and so many of the bunches must be sold by the carload; and, as a rule, choice lots are sought by rival firms, and almost without exception most satisfactory prices are obtained. Personally, I like the plan of culling out the best as they come on, and disposing of them in small lots to local markets or private customers at ruling prices. Split the animal neatly from end to end, wash perfectly clean with a profusion of cold water, and your customers will praise the neat appearance of your goods. The greatest amount of money would be secured by curing the various parts of the animal in the most up-to-date manner, and selling directly to those who will consume the meat.

Improvement to the Farm.

The improvement to the farm because of the introduction of this new industry can hardly be realized. Heavy crops of horse hay can be grown, and the product turned into money. Heavy crops of corn, oats and barley can and should be grown for the support of the various animals kept. Up-to-date machinery must be an important factor in carrying out these plans, because of the scarcity of good farm help. In order to make a beginning, an equipment in the way of stock and accommodations must be gotten together, because brood sows and perhaps some fattening pigs must be wintered over. This wintering over of a good stock pays in more ways than one. The improvement of the farm will be rapid from the large accumulations of manure that must result from this course of farming. As already mentioned, large amounts of first-class horse hay can be grown and turned into money. A gentleman in a near-by town recently told me that he had

harvested eighty tons of the best hay he ever saw stored; and, said he, "I have no use for it whatever, so I put it on the market, and every ton brings twenty dollars. My hogs, which I am obliged to keep to clean up refuse, are responsible for this condition of things on my place." This is only one of many instances where hogs are proving a very remunerative adjunct in the farm economy.

Accommodations.

As for accommodations, start in with what you have, and if you are prospered, you will feel encouraged to arrange more comfortably. Ten good brood sows and a boar is a reasonable number to start with. Some one will say it will not do to count your chickens before they are hatched; but with reasonable success this outfit ought to produce one hundred good pigs every time the sows breed. This season Yorkshire sows have produced remarkably large litters, — in almost every instance from twelve to twenty. With very good care and plenty of milk, every pig could be raised if the sow has a good teat for each one. Almost every New England farm has its variety of buildings and sheds, and with a little good calculation and ingenuity good quarters can be arranged for the winter season. If it were only possible to get farmers to realize that it is not at all necessary to have expensive quarters in order to get the best results, we should hear of more successes and less of failures. Neat, well-arranged quarters are to be advocated; but something of a more primitive nature is preferable to a heavy debt at the start. Let the idea of perfect comfort predominate in every arrangement that is made.

As farrowing time approaches, be sure the sow is in a pen with a good strong rail or plank around the sides, standing out some fifteen inches, and a foot from the floor. A careless mother will lose some pigs, the best you can do. Should the sow be cross, remove the pigs as they come, to some very dry and warm receptacle. About as good and convenient an arrangement as can be made is to fill a large can with hot water, stand it in the middle of a box, wrap about it enough bags or old blankets so the pigs will not be in danger from

burning, and let the little fellows occupy this till the sow takes them good-naturedly, which perhaps may be after two or three have been born, perhaps not till she is through, and in extreme cases in three or four days. After a reasonable time the young ones must have some nourishment, and the sow must be carefully placed on her side and held down till the youngsters have filled themselves. Many advocate the idea of not feeding the sow till the pigs are twenty-four hours old, and the plan works all right; but a little warm water to drink will do no harm. Great care should be taken not to overfeed the sow for the first two weeks.

Arrangement of Plant.

If the business goes well, many farmers will feel encouraged to continue, and the question of a well-arranged plant will come up for consideration. Opinions will differ as to which is the better, all things considered, — one or two very long buildings, or a number of smaller ones systematically arranged, so the effect when viewed from a distance will be pleasing. Both plans have their advantages, and both can be managed successfully. The colony of small buildings has the advantage if disease of any kind breaks out, because at the start probably not more than one lot would be affected, and I consider this isolation of great value. The work of caring for a herd of any size would be less in a long building; still, there would not be very much difference with either system well started. Buildings of any considerable magnitude would refer to the winter management of the stock. In case a long building is thought best, arrange the pens on each side of an alleyway six feet wide, with a track in the middle for a swill tank. The pens should be about ten feet square, though all these dimensions can be changed to suit the fancy of the owner. The floor can be of any material, but the most satisfactory I have tried is to pave with brick. Second-hand brick are all right, and sometimes can be gotten for the asking. In cold weather enough bedding must be used to keep the animals off the floor. The hoof of the hog is very sharp, and will cut through concrete floors in a very short time. Plank floors must be replaced too often. If

the small buildings are thought to be preferable, about ten by sixteen feet, with single roof, is a good size. These buildings can have plank floors, sufficiently off the ground to allow cats to move freely about underneath, because rats and mice will trouble more or less, unless a few good cats are kept. With this precaution, little trouble may be anticipated from this source. This set of buildings can be so arranged as to give the premises a very pleasing appearance. Arranged one after the other in a straight line, and about six feet apart, the work of caring for the stock would not be pleasant, of course, in snow storms; but, aside from this, the plan would work well. For high-priced stock I like this plan much the best. They can be made more comfortable, and in case of disease the loss would be reduced to the minimum. Free ventilation is an absolute necessity. Plenty of sunlight should be admitted.

Winter Feeding.

The summer pork will not cost much, but in winter quite an amount of feed must be provided. I heard a farmer once make the remark — and he was a man who knew what he was saying — that, with corn at a dollar a bushel and pork at seven cents a pound, it paid well to keep hogs. There are so many circumstances and such a variety of conditions under which this class of stock is kept, that instances could be cited where the meat would cost double what it would sell for. Enterprising farmers will produce the greater part of the feed consumed, and this should be charged to the business at what it has cost to produce it. Very much of the feed that a pig has consumed up to five months old does not stand for any value at all.

City Swill.

A word in regard to city swill, so called. Men of the soundest judgment do not hesitate to say that this is the best material for growing the pig; and I think there is no doubt as to the correctness of the statement. The manner of feeding it is in too many cases wrong, and some of it is not worth the hauling; but that collected from hotels, large boarding houses and the like is the best of hog feed. Just before feed-

ing this should be treated with just scalding water sufficient to warm the mass. It is of importance to consider the temperature of the feed. It may be all right to feed cold swill, but we often hear of outbreaks of disease that can be traced directly to the faulty condition of the feed. During my nearly forty years, which has been almost continuous, in the pig business, disease has not troubled in any form, and I do not remember of feeding cold swill at any time. This would seem to be a safe method to follow, but I doubt not many who feed cold swill are equally successful, and in this one must be his own judge as to the safety of the course to be followed.

When to sell.

The good, solid, satisfactory income will depend upon the quality of the pigs being fed. If a pig is kept eight months when fully as good results should have been obtained in six, the profit is not anything as good as it should be. A pair of thoroughbred Berkshires, both barrows, fed on good growing swill, with a finishing-off the last three weeks of as good feed as we could give them, dressed four hundred and five pounds at six months old. This is no enormous weight, and instances can be cited of very much larger weight at this age; but the quality was perfect, and the price obtained was all right.

When to sell is a nice question to decide. As a rule, I have found it best when the pigs are ready and a customer is on hand; but sometimes a delay of a few days might mean one hundred and fifty dollars more on a carload. On the other hand, some disease might break out, and spoil the whole deal. So the owner must be his own judge in the matter. If the pigs are just the right weight and quality, an extra three weeks' gain might be detrimental to a profitable sale. Close watch of market conditions and good judgment are the best guides.

Fencing.

The subject of fencing is worth considering. If a field of some three acres is well fenced with a stone wall, the pigs ought to keep their place; but if larger fields must be divided, there is nothing superior to woven wire three feet high. An

excellent thing to do, when sweet corn gets well filled out and in the milk is to drive along this fence with a small load, and throw in about two stalks to each pig. The corn is much relished, and they seem to chew the stalk for the juice.

It goes without saying that the writer is interested in this pleasant and profitable branch of farming, and has made this class of stock a life-long study; and, although a despised animal, the hog is a very interesting thing in nature. No two are alike in disposition and peculiarities, and a new set of ideas must be studied up for the management of each.

I look for increasing interest along this profitable line of farming, although I appreciate the strong hold of the two rival industries, — dairy and poultry farming. There is room for all of them, and plenty of chance for improvement.

CLEAN MILK: SUGGESTIONS FOR THE AVERAGE PRODUCER.

BY P. M. HARWOOD, GENERAL AGENT, STATE DAIRY BUREAU.

Milk has been truly termed "the world's first food." The importance of a pure, clean article can hardly be overestimated. The health, happiness, vigor and prosperity of a people are in no small degree dependent upon the food consumed, and especially is this true of the food of children, who are later to become the men and women of the nation.

As secreted from the udder of the healthy animal, milk is in perfect condition. In the case of cow's milk, the calf roaming in clean pasture with its mother has a monopoly on the perfect article. The troubles which come to milk most frequently come from without, and are attendant upon artificial conditions. These conditions begin with the housing of the animals, and do not end until the product is finally consumed as food. Added to this is the present artificial method of rearing babies on cow's milk.

The changes which take place in milk are usually caused by the presence and development of certain micro-organisms, vegetable in their nature, known as bacteria; for example, the lactic bacteria which cause souring. Milk also serves as a medium for the conveyance of other forms, known as pathogenic bacteria, all of which do not multiply in the milk, but produce diseases, such as tuberculosis, typhoid fever, scarlet fever, etc.

The bacteria which cause changes in the milk itself multiply with great rapidity after the milk is a few hours old, at certain temperatures. For instance, the bacteria which cause ordinary souring multiply most rapidly at about 70° F. to 80° F., and still others, though more slowly, at about 50° F.

The latter are perhaps most to be dreaded, as they are supposed to be the ones responsible for certain forms of toxic poisoning.

Bacteria get into milk by riding on dirt or any foreign substance; therefore, the simple way to keep milk bacteria-free is to keep it *clean*. This, however, is not entirely possible, but it is possible to reduce contamination to the lowest terms, and then by reduction of temperature place the few bacteria present under conditions where multiplication becomes greatly retarded, — 40° F. or below; then, by holding the milk at that temperature, and by keeping it sealed until ready to use, man's duty to himself and his fellows has been done so far as this milk is concerned. Milk or cream thus handled will keep perfectly as long as needed.

Milk cannot be in perfect condition if the cows are diseased, or if the cows, milk utensils and milk room are handled or the milk distributed by one who has the care of sick persons, or is sick or convalescent from contagious disease himself. Neither can it be in perfect condition if the milkers are not cleanly in their habits, milking always with clean, dry hands; or if food or bedding is shaken so as to fill the air of the stable with dust at or near the time of milking; or if the flanks and udder of the cow are not clean, and damp enough to prevent any material from loosening during the process of milking and falling into the pail. Extra precaution may be taken by drawing a few streams of the first milk into the gutter, thus cleaning the inside of the teat of the stabled cow, and at the same time making sure that there is no udder trouble, garget or bloody milk in any of the quarters; also by milking through a pad of sterilized cotton, though the milk can be strained through such a pad at a later stage, if the producer so prefers. The great advantage of milking through the pad is that the milk is sealed as soon as drawn, and is thus secured from contamination of any sort that might by any chance whatever be present in the stable. The milk when drawn must be removed at once from the stable to the milk room, which should be well lighted, sweet and clean, and so arranged that flies can be kept out. The utensils in this room must be sterilized each time before

using, — steam or hot water and sunlight will do this. Most producers find that an aerator is a good thing to aid in *quick cooling*, and for removing any taint in milk that may be present through food or otherwise. Once cooled below 40° F., the milk vessels should be sealed and the milk kept unexposed until time for use. Perhaps there is no matter connected with the handling of market milk of greater importance than *quick and thorough cooling*.

Of course the healthy cow involves good food, pure water, well-ventilated stables and general sanitary surroundings, and the permanency or success of the business of milk production involves convenience of arrangement and constant vigilance. These do not necessarily involve expensive outlays in cash, though it is admitted that there is a severe demand upon energy, and often a change of old-time routine and habits. If the head of the establishment is all right in his ideas and habits, and puts his energy and personality into his business, the result may be far in advance of that attained by the idealist, who depends more largely upon his money and entirely upon his hired help.

The bulk of the milk consumed in our markets at the present time is made by the so-called average farmer, — a man of limited means, and dependent upon the success of his business for his living. To him the various demands which are from time to time coming up mean much. He cannot afford mistakes; he cannot afford unnecessary outlays. But the public must be protected, and it is the farmer's duty to study the short road to the accomplishment of this by first adopting the essentials and afterwards adding the embellishments, as his trade demands and his means will allow. But be it ever remembered that the production of a practically clean milk is in itself *not a prohibitively expensive operation*. It is the purpose of this article to encourage and if possible help the average dairyman, believing that the persistent producer of unsanitary milk must of necessity ultimately drop the business, and the fancy farmer, so called, can take care of himself.

In order to appreciate the present situation in which the average milk producer, *i.e.*, the man who sells his milk to

contractors and peddlers, finds himself, let us briefly review the evolution of the milk business. Fifty years ago the New England farmer did everything at home, and got all there was in the business up to the point of selling his product, then mainly cheese or butter, to the local storekeeper or country merchant, and those farmers near cities and towns selling milk either direct to the consumer or sometimes to the peddler. In the sixties, cheese factories sprang up, taking the burden of cheese making from the farmhouse, thus relieving the farmer, and especially the farmer's wife, of much hard work. Up to this time the farmer was not only the manufacturer of his own cheese and butter, but also raised all his grain, and made a large amount of pork by keeping hogs fed upon the by-products, whey and skim milk. This establishment of cheese factories was the first step towards concentration in dairying in the districts now covered by the milk contractors. The seventies saw the introduction of creameries, the cheese business being driven to the west. At this time the Boston milk contractors began to reach out sixty or more miles for their supply. The creameries, therefore, within that radius, except in a few isolated instances, were short-lived, and one by one they are dropping out all over the State, New York City drawing milk from southwestern Berkshire, and Boston from the rest of the State, aside from the local consumption by our growing cities and towns.

The business of the Massachusetts dairyman has undergone a wonderful change, — a change as complete in its way as the business of shoe-making, in its transformation from the isolated cobbler in his little house at the cross roads to the great factories in Lynn, Brockton and elsewhere. Dairying has followed the trend of every industry, viz., towards concentration and specialization. On the farms where once flourished cheese making, butter making, swine fattening, beef fattening and the slaughterhouse, where also wheat for the family and grain for the animals were raised, and the flour bolted and the grain ground at the near-by grist mill, and where great manure piles were the result of feeding by-products, — all have given place to the modern milk pro-

ducer, who spends his energies in raising grass and clover for hay and corn for silage, green crops for summer feed, and the milk goes to Boston or elsewhere at the very lowest price the contractors or peddlers can buy it for. The farmer no longer husks his corn or threshes his grain; everything grown is used as coarse fodder. He buys his grain and concentrated feeds, which indirectly helps to keep up the fertility of his farm. He has given up some of his laborious tasks; he has been forced to this, but it is a luxury that has to be paid for. This taking of milk, preparing it for market, mixing and pasteurizing, cooling and rebottling, delivering to peddlers, collecting bills, keeping it up to the standard, paying fines, keeping it cold and the bacteria reduced to board of health regulations, etc., all cost money.

For the last few years the straight price paid by milk contractors in the fifth zone has been 28½ cents in winter and 26½ in summer, amounting to an average of 27½ cents for the milk delivered at the railroad station, which is approximately the price which the average milk producers receive. This is considerably less than half, a little more than one-third, for 8-quart cans which really hold 8½ quarts, the railroads, milk contractors and retailers getting all there is between that and the retail price, — the price which the consumer has to pay for the milk in Boston. It is undoubtedly true that milk contractors can transact their part of the business far more cheaply and more successfully than any one else. But there is one thing which they cannot do, and that is, change milk, by any process whatever, so that it will be better than or as good as "just as the cow secretes it." And in the matter of keeping the milk *practically in this condition* the farmer holds, right in his own hands, if he will, a monopoly which nobody can take from him. The public is fast becoming educated to the fact that this is the only *right milk*. This fact once established, such milk will command generally a higher price at retail; and milk that has, by whatever cause, ever been in such condition that it *needs* pasteurizing, sterilizing, rectifying or any other doctoring, must, notwithstanding the additional cost thereby involved, bring a less price. The result would seem to be that farmers pro-

ducing such milk must ultimately be recompensed for their efforts.

Furthermore, if the milk produced for the Boston market could be delivered at the stations in condition such as to do away with pasteurizing, rectifying, etc., it should so reduce the expense of handling that a better allowance could be meted out to the farmers by the contractors. An improved product also means greater consumption, hence increased market. The consumer should be willing to pay a fair price for clean milk. A rise of 1 cent per quart per day means $3.65 per year, or $1.21 per person, on the basis of two-thirds of a pint, the milk consumption per capita in the large cities, as reported last year by the United States Department of Agriculture, or practically $6 per year for a family of five persons. What head of a family would not give $6 per year to insure milk made under sanitary conditions? It might mean a yearly sacrifice of 60 10-cent cigars, or 40 15-cent drinks of whiskey, or even 120 glasses of beer, or some other six-dollar sacrifice, but the saving of doctor's bills and increased health of children ought to be a sufficient reward.

About the year 1814 distilleries were started in the United States, and with them came the disposition of the by-product "slop" by feeding it to cows huddled together in close, unsanitary stables, usually in or near the large cities. The result of this and other unsanitary conditions was a quality of milk which wrought havoc among the consumers. The mortality among children under five years of age in Philadelphia in 1814 was around 25 per cent, and in Boston not far from 30 per cent of the total deaths. As the distillery and brewing business developed, by 1840, among children of like age in New York and Philadelphia, the mortality had reached over 50 per cent of the total deaths, and in Boston[1] over 40 per cent. These figures were held with more or less variation for a number of years. The report of the board of health of the city of Boston for 1904 shows the gradual improvement during the last thirty years in the care and feeding of children in that city by the following mortality figures: 1875, 43.84 per cent; 1880, 39.26 per cent; 1885,

[1] Mostly breweries near Boston.

36.03 per cent; 1890, 32.89 per cent; 1895, 34.73 per cent; 1900, 32.13 per cent; and 1904, 28.87 per cent. New York and Philadelphia show similar improvement.

There can be no doubt but that this change for the better, shown by these statistics, is in no small degree due to the improvement of the farm conditions, the wisdom of our laws and health regulations, and the educational efforts which have been put forth by interested persons.

When, as a result of the evils ensuing on the feeding of distillery slop, etc., to dairy cows, and the inhumane and unsanitary housing and care of such cows, the mortality of young children was from 40 to 50 per cent of total deaths, the conditions were much worse than now. Indeed, at no period in our history for the past hundred years has the death rate of children under five years of age in the city of Boston been so small as it is at the present time, and never before during all that time has the milk been delivered in our cities in such good condition as it is to-day. Never before could buyers feel the assurance that they were getting so good, pure and clean an article of milk or cream.

As another illustration of the fact that things are not as bad as they are sometimes painted, last winter one of our most up-to-date milk contractors had the milk from the entire number of farmers, 119, furnishing him milk from a single town, examined for bacteria, and found that only 2½ per cent were outside the Boston requirements, and 83 per cent were below one-tenth of these same requirements. This may be taken as a fair illustration of things as found in a community of intelligent milk producers.

Scare-heads and sensational articles in the papers relating to the finding of filthy conditions in isolated dairies, thus magnifying the condition as a whole to make it appear inversely to what it is, are to be deplored, especially in so far as they frighten people against the use of milk. Milk is of such immense value as food, and is so cheap as compared with the same amount of nutriment in other forms, that its use should be encouraged as much as possible. But, good as present conditions are, we want better.

I like to encourage the average milk producer, — he of all

men has my sympathy. For years I was one myself. I am not going to decry a separate stable for the cattle, or the wing attachment to the hay barn, — the modern idea. These are all right if properly constructed, and the owner can afford them. But the man with the stable in the first floor of the hay barn, with a cellar underneath, thus combining all under one roof, saving expense and labor, need not "give up the ghost" so far as the production of clean milk is concerned. If he will keep effluvia reduced to lowest terms and out of the stable, and dirt out of milk by adopting the best known methods of milking, and take his milk at once from the stable upon drawing, remembering that whether his milk is clean or not depends upon him, and not upon his wealth or costly buildings or upon extravagances or luxuries of any kind, he will meet with success. It is a great mistake to copy from wealthy fancy farmers any costly or *unnecessary* device. Many a man has kept himself poor by so doing. As an illustration of what can be done by confining one's self to essentials, I cite the following instance.

There is in this State a barn that accommodates some 30 head of cattle, costing not over $1,250 above the foundation, constructed with the utmost care as to economy, and utilizing to the very best advantage every foot of space, one roof covering hay, carriage room and stable, horses and cows kept together in a stable always warm, never too cold in winter or too hot in summer, never damp, always sweet, even though hogs run upon the manure in the barn cellar. The walls of this stable are double, and provided with the King system of ventilation, thus insuring good air and at the same time warmth. The room is exposed on three sides, and is abundantly supplied with windows, double for winter, and with fly screens in summer. Even the milk room is under the same roof, but it is so far separated from the stable that no odors can reach it. If all the farmers of the Commonwealth should use as much common-sense, vigilance and care as this man, they could make the best of milk, and at the same time, with a slight increase in price, a fair living. The product of this farm is cream, the skimmed milk being fed out upon the premises, and the land improved in fertility from

year to year. These ideas are applicable to almost any stable in the average barn, and at no great cost.

Forty or fifty years ago the barns were perfectly ventilated, with half-inch cracks between the boards, but too cold to make milk in economically. Farmers were advised to reboard the barns with matched boards and then inclose the stables, making them air tight, and not to turn their cows out to water, and even to warm the water. Result, vitiated air, no exercise for cattle, debility and tuberculosis. This caused great financial loss to the farmers, and the expenditure of hundreds of thousands of dollars by the State to eradicate the disease thus engendered. Next, farmers were advised to build stables large enough to furnish certain air space per cow; and these often proved to be too cold in winter, too warm in summer, and sometimes too damp when closed. It is admitted that such stables need not have these faults, provided they are properly constructed. These changes have been costly, and those who have managed to live through them, financially and otherwise, can hardly be blamed if they are inclined to go a little slow along the line of further outlay.

In the beginning of this article milk as secreted from the healthy cow was taken as ideal. The health of the animal, therefore, becomes a matter of prime importance. Suitable feed, pure water, good ventilation, proper exercise and good care are all necessary. The confinement of cows in stables is, of course, unnatural, but has to be endured like all artificialities. The question comes on where to draw the line between essentials and non-essentials, and that is usually governed by common-sense and the exigencies of the case. There is such a thing as being "more nice than wise;" and the successful dairyman will be the one who can draw this line aright, thus accomplishing results with minimum expense. Some people object to using stanchions; but the stanchion is not hard for the cow after she becomes used to it. Tying a cow up at all might with equal propriety be considered cruel. The real inhumanity comes from the practice of keeping the cows in stables *all the time;* and, as a limited amount of exercise in the open air is

highly essential to perfect health, it is a serious question whether or not water in front of a cow is altogether a good thing, especially if the cow is thereby deprived of her daily exercise. Such contrivances are costly on the one hand, but are convenient and labor-saving on the other.

To keep cows clean involves time and labor; how to reduce these to lowest terms is important. There is a variety of tie-ups, and about as many different opinions regarding the same. Probably for most dairymen some form of stanchion will, on the whole, be best. This because the cow is held more firmly in place, and cannot track so much manure upon the platform, as is often the case where a cow is fastened by chains; and then, too, with stanchions it is possible to fasten a short chain to one upright by staple in front or rear, just below the throat of the cow, and in the other upright there should be a staple with an eye. The chain, provided with a snap at one end, should be just long enough to reach across and catch into this eye. This chain can be used to keep the cow from lying down after she has been cleaned, and unfastened after the milking has been accomplished.

The floor planks in the platform must be of proper length, and should always be as short as possible for the cow to stand on comfortably, and if the cows vary in size, should be, say, 4 feet 2 inches at one end and 4 feet 8 inches, more or less, at the other, depending upon the size of the cows, and the cows tied according to size, the smallest at one end and so on up to the largest. The gutter behind the cows should be as deep as the circumstances will allow, and not too wide. By this arrangement the manure is dropped in the gutter, and but little on the platform. By keeping the manure off the cows, much subsequent labor is saved.

The cows during periods of confinement in the stable should be groomed enough to keep them clean, aside from cleaning their flanks and udders. This work can be easily and quickly done by using a partially worn-out broom with a part of the handle sawed off. A man with snap in him, a live man, with this implement, using both hands, can go over a fair-sized herd of animals in the time usually taken

by the average hired man in grooming two or three animals with the curry comb and brush.

With the stanchions and cross chain already described the cows can be made to remain standing while the udder and flanks are cleaned, washed if need be, and thoroughly wiped, and left in a damp but not wet condition. If clean milk is to be drawn, there must be no dirt or loose skin left upon the cow, or upon the milker's hands, that can by any means get into the pail.

A good pail to use can be made by any tinsmith, and should be either seamless or carefully and smoothly soldered. There should be soldered upon the top a cover with a round opening of not more than 6½ inches in diameter, into which is placed and not fastened a strainer dish 7 inches across the top and 6 inches across the bottom.[1] This strainer should be a tin dish, with a bottom mesh of fine copper wire. At each milking two thin layers of sterilized absorbent cotton, the fibre of one layer across the fibre of the other, should be placed in the dish, and over this sterilized strainer cloth, which should come up and over the sides of the dish, and be secured by a ring of tin snugly fitting the inside of the dish. Care must be taken to have the dish not less than 2½ inches deep and the ring inside 3 inches deep, thus projecting somewhat above the top of the dish, otherwise the milk will be liable to spatter out. At the side of the pail and as near the top as can be placed there should be a short spout for emptying, and this should be kept covered with a cap when the pail is in use, this cap being removed only when necessary to pour out the milk. The pad of cotton forms a perfect strainer for minute chance dirt which has thus far escaped the utmost care, and also as soon as wet it practically seals the milk from the stable air. It is a safeguard from contamination by flies, and should be thrown away at the end of the milking. Such a pad costs about ¼ of a cent, and, properly used, will last while milking from 10 to 15 cows. There should be no feeding or raising of dust in the stable just before or during milking time.

---

[1] The size of this opening and the dish may be larger, or even smaller, if desired. The farmer should choose a size to suit his conditions.

The milk once drawn should be taken immediately to the milk room, which should always be outside the stable, and preferably though not necessarily outside the barn, and should, with all utensils, be kept scrupulously clean, and in summer time thoroughly protected from flies. The milk should here be aërated and cooled at once to 40° F. or below. If cream is separated, the same practices regarding cleanliness must be observed, and the cream at once cooled and bottled. Milk or cream thus produced and kept at proper temperature I have personally known to keep *in perfect condition* ten days or more.

All this may seem a difficult task, it is so different from old customs; but it is essential. Compare it, for instance, with daily removing manure and spreading it on the land, — a practice often recommended, which I do not condemn if a person desires and can afford to do it that way. But the time taken up in harnessing and unharnessing for one load, when it would take no longer to do it for twenty loads, and the more or less wasteful practice of applying manure at times when it cannot readily be incorporated with the soil, but must be subject, for a greater or less period, to the wasting influence of washing from rain and melting snow and drying by sun and wind, do not commend it as a practical method of handling farm manure to the best advantage. The old-time barn-cellar, if properly cared for, is still the most economical place in which to temporarily care for manure, and if the stable floor is tight, frequently cleaned, and the cellar properly ventilated, there need be no contamination.

All this should mean an increased price for market milk, to reimburse the producer. Beyond what is here advised, the maker of a fancy article of milk can go to any extent he pleases, and his purse and those of his customers will allow. But for all practical purposes, milk made in this manner will be good enough for anybody, and will be as good as the average producer can afford to make, or the average consumer buy.

FINANCIAL RETURNS

AND

ANALYSIS OF PREMIUMS AND GRATUITIES

OF THE

INCORPORATED SOCIETIES.

WITH MEMBERSHIP AND INSTITUTES,

FOR THE YEAR 1905.

FINANCIAL RETURNS OF THE INCORPORATED

	SOCIETIES.	When incorporated.	Amount originally raised by Contribution. (R. L. 124, Sects. 1 and 3.)	Amount now held invested as Capital Stock. (R. L. 124, Sects. 3 and 12.)	Estimated Market Value of Property.	Total Assets.
1	Amesbury and Salisbury (Agricultural and Horticultural),	1881	$1,002 32	[2] $8,126 77	$8,126 77	$8,156 01
2	Barnstable County,	1844	1,740 00	[3] 8,300 00	8,300 00	9,117 00
3	Blackstone Valley,	1884	3,000 00	[2] 4,500 00	4,500 00	4,515 00
4	Deerfield Valley,	1871	4,094 01	[4] 9,200 00	9,450 00	9,510 14
5	Eastern Hampden,	1856	3,000 00	[4] 7,000 00	7,000 00	7,069 21
6	Essex,	1818	4,547 20	[5] 23,305 00	23,497 07	23,497 07
7	Franklin County,	1850	3,768 00	[6] 11,000 00	11,165 72	11,165 72
8	Hampshire,	1850	3,255 26	[2] 5,150 00	5,150 00	5,197 42
9	Hampshire, Franklin and Hampden,	1818	8,141 29	[7] 8,723 24	8,723 34	8,723 24
10	Highland,	1859	3,262 00	[2] 3,262 00	3,262 00	3,294 81
11	Hillside,	1883	3,113 32	[7] 5,900 00	5,800 00	5,843 78
12	Hingham (Agricultural and Horticultural),	1867	17,406 15	[7] 4,640 98	4,640 98	4,640 98
13	Hoosac Valley,	1860	2,006 00	[2] 16,800 00	16,800 00	17,382 99
14	Housatonic,	1848	6,335 33	[8] 25,187 04	25,612 04	26,227 39
15	Marshfield (Agricultural and Horticultural),	1867	3,755 43	[2] 14,050 00	14,050 00	14,366 28
16	Martha's Vineyard,	1859	4,552 17	[9] 4,092 44	4,092 44	4,170 41
17	Massachusetts Horticultural,	1829	525 00	[10] 564,524 70	848,266 18	848,266 18
18	Massachusetts Society for Promoting Agriculture,[1]	1792	–	–	–	–
19	Middlesex North,	1855	3,000 00	[2] 35,500 00	35,500 00	35,858 59
20	Middlesex South,	1854	3,000 00	[4] 12,000 00	12,200 00	12,289 38
21	Nantucket,	1856	3,500 00	[4] 3,200 00	3,200 00	3,227 57
22	Oxford,	1888	4,400 00	[7] 9,294 22	9,294 22	9,294 22
23	Plymouth County,	1819	9,550 00	[11] 1,587 01	1,582 93	1,587 01
24	Spencer (Farmers' and Mechanics' Association),	1888	4,034 00	[2] 10,350 00	10,350 00	10,517 20
25	Union (Agricultural and Horticultural),	1867	4,447 23	[2] 9,000 00	9,000 00	9,095 06
26	Weymouth (Agricultural and Industrial),	1891	10,270 00	[2] 11,270 00	11,270 00	11,372 63
27	Worcester,	1818	7,730 00	[12] 88,086 34	89,550 84	90,142 46
28	Worcester East,	1890	2,296 23	[13] 8,598 82	8,598 82	8,598 82
29	Worcester Northwest (Agricultural and Mechanical),	1867	3,400 00	[2] 13,600 00	13,600 00	13,820 67
30	Worcester South,	1855	3,127 40	[13] 11,079 77	11,023 50	11,079 77
31	Worcester County West,	1851	3,175 00	[2] 13,600 00	13,600 00	13,700 43
			$138,673 34	$950,928 33	$1,237,206 75	$1,241,727 44

[1] Represented on the Board by special enactment, and makes no returns.
[2] Invested in real estate, crockery, tables, etc.
[3] Invested in real estate and bonds.
[4] Invested in real estate.
[5] Invested in real estate, stocks, crockery, tables, etc.
[6] Invested in real estate and stocks.
[7] Invested in real estate, bank funds, crockery, tables, etc.

Societies for the Year ending Dec. 31, 1905.

Real Estate.	Notes.	Stocks and Bonds.	Bank Funds.	Bills due and unpaid.	Crockery, Tables, etc.	Cash on Hand.	Total Liabilities.	
$7,721 49	-	-	-	-	$405 28	-	$1,500 00	1
7,500 00	-	-	$800 00	-	-	$817 00	1,800 00	2
4,400 00	-	-	-	$7 00	100 00	8 00	2,072 25	3
9,200 00	-	-	-	-	250 00	60 14	-	4
7,000 00	-	-	-	67 00	-	2 21	6,981 89	5
15,300 00	-	$7,805 00	-	200 00	-	192 07	10,777 95	6
10,000 00	-	1,000 00	-	-	-	165 72	6,782 00	7
5,000 00	-	-	47 42	-	150 00	-	2,000 00	8
8,000 00	-	-	323 24	-	400 00	-	2,650 00	9
3,000 00	-	-	-	-	262 00	32 81	50 00	10
5,000 00	-	-	450 00	-	350 00	43 78	-	11
3,000 00	-	-	600 00	-	1,000 00	40 98	-	12
16,300 00	-	-	-	-	500 00	582 99	10,000 00	13
22,000 00	-	500 00	2,687 04	25 00	425 00	590 35	5,917 50	14
13,300 00	-	-	-	-	750 00	316 28	2,148 89	15
2,750 00	$150 00	-	942 44	3 00	250 00	74 97	26 00	16
561,115 01	-	260,888 50	12,992 90	3,488 76	9,781 01	-	6,506 00	17
-	-	-	-	-	-	-	-	18
35,000 00	-	-	-	-	500 00	358 89	22,525 35	19
12,000 00	-	-	-	87 00	200 00	2 38	7,945 15	20
3,200 00	-	-	-	-	-	27 57	572 24	21
7,600 00	-	-	820 00	-	200 00	674 22	-	22
-	-	-	1,545 93	-	37 00	4 08	-	23
9,400 00	-	-	-	-	950 00	167 20	2,200 00	24
8,000 00	-	-	-	-	1,000 00	95 06	1,315 23	25
11,000 00	-	-	-	-	270 00	102 63	2,500 00	26
58,000 00	-	-	30,000 00	591 62	1,464 50	86 34	1,672 11	27
7,235 85	-	-	-	-	75 00	1,287 97	-	28
13,000 00	-	-	-	-	600 00	220 67	4,900 00	29
10,400 00	-	-	-	-	300 00	379 77	1,739 32	30
12,600 00	-	-	-	-	1,000 00	100 43	700 00	31
$888,022 35	$150 00	$270,193 50	$51,208 97	$4,469 38	$21,219 79	$6,434 51	$105,281 88	

[8] Invested in real estate, stocks and bank funds.
[9] Invested in real estate, notes, bank funds, crockery, tables, etc.
[10] Invested in real estate, library, furniture, bonds and other securities.
[11] Invested in bank funds, cash, crockery, tables, etc.
[12] Invested in real estate and bank funds.
[13] Invested in real estate, cash, crockery, tables, etc.

FINANCIAL RETURNS OF THE INCORPORATED SOCIETIES

	SOCIETIES.	Premiums due and unpaid.	Outstanding Bills.	Mortgages or Like Liabilities.	Total Receipts.	Bounty.	Income from Notes and Bank Funds.
1	Amesbury and Salisbury (Agricultural and Horticultural),	–	–	$1,500 00	$1,769 95	$574 80	–
2	Barnstable County,	–	–	1,800 00	6,428 80	600 00	$32 00
3	Blackstone Valley,	–	136 50	1,935 75	1,358 99	547 50	–
4	Deerfield Valley,	–	–	–	2,077 01	600 00	–
5	Eastern Hampden,	–	579 22	6,402 67	4,745 33	600 00	–
6	Essex,	–	–	10,777 95	2,463 09	600 00	–
7	Franklin County,	–	25 00	6,757 00	7,188 59	600 00	–
8	Hampshire,	–	–	2,000 00	1,770 06	600 00	56 64
9	Hampshire, Franklin and Hampden,	–	650 00	2,000 00	5,269 60	600 00	49 67
10	Highland,	–	–	50 00	1,914 30	600 00	–
11	Hillside,	–	–	–	1,667 95	600 00	20 00
12	Hingham (Agricultural and Horticultural),	–	–	–	1,149 80	577 20	–
13	Hoosac Valley,	–	–	10,000 00	2,748 28	–	–
14	Housatonic,	–	25 00	5,892 50	13,057 65	600 00	38 92
15	Marshfield (Agricultural and Horticultural).	$42 80	–	2,106 09	4,086 35	600 00	–
16	Martha's Vineyard,	9 00	17 00	–	1,138 21	600 00	56 57
17	Massachusetts Horticultural,	[2] 6,506 00	–	–	21,312 37	600 00	210 72
18	Massachusetts Society for Promoting Agriculture,[1]	–	–	–	–	–	–
19	Middlesex North,	284 35	441 00	21,800 00	3,013 46	600 00	–
20	Middlesex South,	45 15	50 00	7,850 00	2,079 15	600 00	–
21	Nantucket,	–	–	572 24	1,291 29	600 00	–
22	Oxford,	–	–	–	4,341 80	600 00	20 00
23	Plymouth County,	–	–	–	297 50	211 50	26 25
24	Spencer (Farmers' and Mechanics' Association),	–	200 00	2,000 00	3,250 28	600 00	–
25	Union (Agricultural and Horticultural),	1 63	13 60	1,300 00	2,274 39	600 00	–
26	Weymouth (Agricultural and Industrial),	–	100 00	2,400 00	3,032 08	600 00	211 88
27	Worcester,	–	1,672 11	–	15,453 99	600 00	1,270 28
28	Worcester East,	–	–	–	8,199 53	600 00	48
29	Worcester Northwest (Agricultural and Mechanical),	–	–	4,900 00	6,459 42	600 00	–
30	Worcester South,	116 40	22 92	1,600 00	5,552 00	600 00	–
31	Worcester County West,	–	–	700 00	3,904 15	600 00	–
		$7,005 33	$3,932 35	$94,344 20	$139,295 37	$16,911 00	$1,993 41

[1] Represented on the Board by special enactment, and makes no returns.

[2] Awarded in 1905; to be paid in 1906.

FOR THE YEAR ENDING DEC. 31, 1905 — *Concluded.*

Income from Stocks and Bonds.	Received from New Members.	Received as Donations.	Received from All Other Sources.	Total Expenditures.	Premiums and Gratuities paid.	Current Running Expenses.	Interest.	All Other Expenses.	
-	$3 00	$56 60	$1,135 55	$1,453 66	$709 80	$688 36	$55 50	-	1
-	15 00	-	5,781 80	5,611 80	2,243 65	3,278 15	90 00	-	2
-	6 00	-	805 49	1,350 99	673 10	-	101 80	$576 09	3
-	51 00	7 75	1,418 26	2,016 87	1,086 80	923 17	6 90	-	4
-	28 00	75 96	4,041 37	4,743 08	752 72	1,602 16	284 00	2,104 20	5
$346 00	36 00	-	1,481 09	2,525 55	[3] 1,237 00	657 53	526 12	104 90	6
40 00	-	-	6,548 59	7,025 61	2,469 80	1,519 49	317 14	2,719 18	7
-	72 50	176 87	864 05	1,722 64	616 40	445 69	99 60	560 35	8
-	71 00	77 00	4,471 93	6,771 76	1,034 25	1,358 36	-	4,379 15	9
-	20 00	125 00	1,169 30	1,881 49	849 00	427 09	5 40	600 00	10
-	132 00	24 37	891 58	1,720 59	1,071 20	400 00	-	249 39	11
-	1 00	15 85	555 75	909 31	567 65	303 85	-	37 81	12
-	10 00	-	2,738 28	2,665 29	760 00	1,405 29	500 00	-	13
55 00	278 00	-	12,085 73	13,149 58	1,923 50	4,234 47	250 00	6,741 61	14
-	15 00	-	3,471 35	4,686 35	1,219 45	2,458 03	[4] 408 87	-	15
-	10 00	14 10	457 54	1,206 11	668 16	294 09	6 00	237 06	16
10,865 00	1,810 00	1,000 00	6,826 85	20,588 27	[3] 5,972 92	12,785 23	-	1,830 12	17
-	-	-	-	-	-	-	-	-	18
-	6 00	-	2,407 46	2,623 87	824 80	225 00	441 00	1,133 07	19
-	-	14 00	1,465 15	2,076 77	1,075 91	795 73	55 25	149 88	20
-	19 00	-	672 29	1,263 72	606 25	657 47	-	-	21
-	26 00	-	3,695 80	2,829 58	1,487 35	739 69	-	602 54	22
-	-	-	59 75	295 94	214 75	81 19	-	-	23
-	10 00	-	2,640 28	3,250 25	1,806 37	1,443 88	-	-	24
-	37 00	5 00	1,632 39	2,179 33	1,133 06	701 45	138 75	206 07	25
-	40 00	15 65	2,164 55	3,032 08	603 48	150 00	145 00	2,133 60	26
-	65 00	-	13,518 71	15,406 15	4,825 93	1,580 90	30 56	8,968 76	27
-	11 00	510 00	7,078 05	6,988 17	1,728 65	5,008 39	-	251 13	28
-	-	-	5,859 42	6,338 45	2,407 25	3,735 45	195 75	-	29
-	25 00	-	4,927 00	4,240 66	1,763 90	1,755 26	127 50	594 00	30
-	45 00	59 89	3,199 26	3,584 17	1,889 56	1,642 43	52 18	-	31
$11,306 00	$2,842 50	$2,178 04	$104,064 62	$133,538 09	$44,222 66	$51,297 80	$3,837 32	$34,179 51	

[3] Awarded in 1904.

[4] And principal paid.

ANALYSIS OF PREMIUMS AND GRATUITIES, MEMBERSHIP AND

	SOCIETIES.	Total Amount offered in Premiums.	Total Amount awarded in Premiums and Gratuities.	Total Amount paid in Premiums and Gratuities.	Amount offered under Head of Farms, etc.	Amount awarded under Head of Farms, etc.	Amount paid under Head of Farms, etc.	Amount offered under Head of Farm and Pet Stock.
1	Amesbury and Salisbury (Agricultural and Horticultural), ...	[2] $776 40	$776 40	$709 80	-	-	-	$269 75
2	Barnstable County, . .	2,814 00	2,243 65	2,243 65	$127 00	$5 00	$5 00	645 00
3	Blackstone Valley, . .	1,027 90	673 10	673 10	135 00	45 00	45 00	703 50
4	Deerfield Valley, . . .	1,456 75	1,086 80	1,086 80	-	-	-	882 00
5	Eastern Hampden, . .	1,035 60	752 72	752 72	98 00	10 00	10 00	665 00
6	Essex, ...	2,051 00	1,193 95	[3] 1,237 00	-	-	-	1,244 00
7	Franklin County, . . .	2,634 00	2,469 80	2,469 80	-	-	-	1,300 00
8	Hampshire, ...	1,248 40	629 05	616 40	25 00	-	-	904 00
9	Hampshire, Franklin and Hampden, ...	1,508 00	1,082 00	1,034 25	50 00	-	-	1,018 00
10	Highland, ...	806 70	849 00	849 00	-	-	-	606 50
11	Hillside, ...	1,237 45	1,083 70	1,071 20	-	-	-	784 00
12	Hingham (Agricultural and Horticultural), . . .	1,344 75	567 65	567 65	92 75	-	-	-
13	Hoosac Valley, ...	1,000 00	760 00	760 00	-	-	-	-
14	Housatonic, ...	2,647 00	1,923 50	1,923 50	-	-	-	1,627 00
15	Marshfield (Agricultural and Horticultural), . .	1,775 40	1,256 35	1,219 45	126 00	-	-	526 50
16	Martha's Vineyard, . .	877 13	663 43	668 16	39 00	8 00	8 00	460 00
17	Massachusetts Horticultural,	6,880 00	5,634 57	[3] 5,972 92	583 00	188 00	[3] 347 00	-
18	Massachusetts Society for Promoting Agriculture,[1] .	-	-	-	-	-	-	-
19	Middlesex North, . . .	1,265 70	1,109 15	824 80	-	-	-	637 35
20	Middlesex South, . . .	1,550 00	1,146 06	1,075 91	[4] -	[4] -	21 00	[4] -
21	Nantucket, ...	1,400 00	606 25	606 25	96 00	5 00	5 00	690 00
22	Oxford, ...	1,900 00	1,565 00	1,487 35	78 00	46 50	46 50	884 00
23	Plymouth County, . . .	282 75	214 75	214 75	75 00	-	-	-
24	Spencer (Farmers' and Mechanics' Association), .	2,611 00	1,945 50	1,806 37	72 00	30 00	30 00	1,228 00
25	Union (Agricultural and Horticultural), . . .	1,651 60	1,159 00	1,133 06	-	-	-	815 00
26	Weymouth (Agricultural and Industrial), . . .	1,170 15	632 23	603 48	-	-	-	679 00
27	Worcester, ...	5,696 00	4,843 45	4,825 93	-	-	-	3,956 50
28	Worcester East, ...	2,500 00	1,760 50	1,728 65	32 00	19 00	19 00	1,655 50
29	Worcester Northwest (Agricultural and Mechanical), .	2,753 00	2,458 50	2,407 25	-	-	-	1,454 25
30	Worcester South, . . .	2,300 00	1,840 70	1,763 90	97 00	36 00	36 00	919 00
31	Worcester County West, .	2,298 70	1,949 45	1,889 56	57 00	26 00	24 00	1,134 00
		$58,499 38	$44,876 21	$44,222 66	$1,782 75	$418 50	$596 50	$25,687 85

[1] Held no fair and made no report. [2] Awarded in 1904. [3] Total paid.

INSTITUTES, FOR THE YEAR ENDING DEC. 31, 1905.

Amount awarded under Head of Farm and Pet Stock.	Amount paid under Head of Farm and Pet Stock.	Amount offered under Head of Field and Garden Crops.	Amount awarded under Head of Field and Garden Crops.	Amount paid under Head of Field and Garden Crops.	Amount offered under Head of Farm and Garden Products.	Amount awarded under Head of Farm and Garden Products.	Amount paid under Head of Farm and Garden Products.	Amount offered under Head of Dairy Products.	Amount awarded under Head of Dairy Products.	
$269 75	$269 75	-	-	-	$159 75	$159 75	$159 75	-	-	1
399 50	399 50	$175 00	-	-	383 75	309 20	309 20	$10 00	$8 00	2
418 00	418 00	-	-	-	115 40	65 90	65 90	10 00	-	3
615 00	607 50	-	-	-	127 75	64 85	64 60	12 00	3 00	4
585 75	585 75	47 50	$27 25	$27 25	97 00	102 70	102 70	47 00	30 00	5
618 75	[2] 794 00	-	-	-	500 00	389 00	[3] 387 00	14 00	4 00	6
1,159 05	1,159 05	-	-	-	200 00	198 80	198 80	24 00	14 00	7
376 00	362 00	-	-	-	132 00	115 00	103 00	13 00	3 00	8
849 50	834 25	89 00	8 00	5 00	193 00	128 00	122 00	36 00	11 00	9
653 55	653 55	26 00	20 00	20 00	63 25	60 50	60 50	5 00	5 00	10
615 60	615 60	60 00	63 00	63 00	80 00	75 45	75 45	11 00	8 00	11
-	-	131 00	14 00	14 00	878 75	432 20	432 20	3 50	3 75	12
418 00	418 00	-	-	-	-	43 50	43 50	[4] –	10 00	13
1,102 30	1,102 30	212 00	212 00	212 00	291 00	275 50	275 50	34 00	28 00	14
269 40	238 40	87 50	3 00	3 00	200 00	172 35	167 35	12 00	5 00	15
290 25	290 25	151 15	83 50	83 50	34 00	81 50	81 50	13 00	11 65	16
-	-	-	-	-	6,297 00	5,446 57	[3] 5,769 18	-	-	17
-	-	-	-	-	-	-	-	-	-	18
687 00	428 25	-	-	-	469 85	314 40	301 55	4 50	-	19
[4] –	125 00	[4] –	[4] –	4 50	[4] –	[4] –	63 00	-	-	20
252 00	252 00	143 00	153 00	53 00	127 00	61 75	61 75	16 00	-	21
693 50	678 50	38 25	34 25	34 13	78 50	46 50	41 32	12 00	6 00	22
-	-	7 50	7 50	7 50	169 25	156 00	156 00	-	-	23
785 00	785 00	-	-	-	176 50	112 25	112 25	325 00	231 00	24
503 50	489 89	-	-	-	73 00	45 25	43 38	13 25	8 75	25
335 78	307 63	46 00	13 00	13 00	210 00	113 20	113 20	5 00	1 25	26
3,143 50	3,143 50	-	-	-	484 00	451 00	451 00	29 00	26 00	27
1,164 00	1,148 50	-	-	-	338 25	258 25	250 25	21 00	10 00	28
1,165 25	1,162 00	-	-	-	313 75	165 25	149 00	18 00	3 00	29
759 00	716 00	-	-	-	197 00	111 50	111 50	25 00	23 00	30
892 50	836 50	-	-	-	147 95	124 25	122 36	15 00	8 00	31
$19,021 43	$18,820 07	$1,213 90	$538 50	$539 88	$12,537 70	$10,080 37	$10,394 69	$716 25	$461 40	

[4] Not reported.

ANALYSIS OF PREMIUMS AND GRATUITIES, MEMBERSHIP AND

	SOCIETIES.	Amount paid under Head of Dairy Products.	Amount offered under Head of Domestic Manufactures.	Amount awarded under Head of Domestic Manufactures.	Amount paid under Head of Domestic Manufactures.	Amount awarded under Head of Miscellaneous.	Amount paid under Head of Miscellaneous.
1	Amesbury and Salisbury (Agricultural and Horticultural),	–	$116 40	$116 40	$116 40	$187 00	$187 00
2	Barnstable County,	$88 00	208 25	256 75	256 75	47 20	47 20
3	Blackstone Valley,	–	33 50	30 70	30 70	30 50	30 50
4	Deerfield Valley,	3 00	105 95	88 45	88 45	45 50	45 50
5	Eastern Hampden,	30 00	29 75	19 70	19 70	51 35	51 35
6	Essex,	–	204 00	93 20	[3] 150 05	89 00	[3] 165 00
7	Franklin County,	14 00	40 00	28 75	28 75	69 20	69 20
8	Hampshire,	3 00	60 00	57 05	49 00	78 00	102 40
9	Hampshire, Franklin and Hampden,	11 00	76 00	39 50	28 50	46 00	33 50
10	Highland,	5 00	65 25	69 25	69 25	40 70	40 70
11	Hillside,	8 00	83 00	82 20	82 20	69 45	69 45
12	Hingham (Agricultural and Horticultural),	3 75	133 75	73 70	73 70	44 00	44 00
13	Hoosac Valley,	10 00	[2] –	141 35	141 35	28 75	28 75
14	Housatonic,	28 00	483 75	301 10	301 10	–	–
15	Marshfield (Agricultural and Horticultural),	5 00	131 00	114 20	110 90	37 40	35 90
16	Martha's Vineyard,	11 65	96 75	105 20	105 20	83 33	83 33
17	Massachusetts Horticultural,	–	–	–	–	–	–
18	Massachusetts Society for Promoting Agriculture,[1]	–	–	–	–	–	–
19	Middlesex North,	–	154 00	107 75	95 00	–	–
20	Middlesex South,	–	[2] –	[2] –	34 00	[2] –	97 00
21	Nantucket,	–	128 00	70 75	70 75	63 75	63 75
22	Oxford,	5 75	76 50	51 25	47 12	12 00	12 00
23	Plymouth County,	–	31 00	51 25	51 25	–	–
24	Spencer (Farmers' and Mechanics' Association),	231 00	69 50	47 25	47 25	20 00	20 00
25	Union (Agricultural and Horticultural),	8 75	116 25	107 45	98 36	129 05	128 68
26	Weymouth (Agricultural and Industrial),	1 25	165 15	121 35	121 35	47 65	47 65
27	Worcester,	26 00	46 25	42 50	42 50	164 95	164 95
28	Worcester East,	10 00	209 75	120 50	118 50	189 75	182 40
29	Worcester Northwest (Agricultural and Mechanical),	3 00	76 50	42 75	31 25	4 00	4 00
30	Worcester South,	23 00	69 75	64 70	64 70	46 50	44 50
31	Worcester County West,	8 00	69 75	43 70	43 70	–	–
		$457 15	$3,079 75	$2,488 70	$2,517 73	$1,625 03	$1,798 71

[1] Held no fair and made no report. [2] Not reported. [3] Total paid.

INSTITUTES, FOR THE YEAR ENDING DEC. 31, 1905 — *Concluded.*

Amount paid for Trotting.	Number of Persons receiving Premiums.	Number of Persons receiving Gratuities.	Number of Cities and Towns where Premiums were paid.	Amount paid to Parties Outside the State.	Number of Male Members.	Number of Female Members.	Total Membership.	Number of Institute Sessions held.	Average Number attending Institutes.	
$43 50	[4] 659	–	[2] –	$123 00	194	40	234	3	52	1
1,218 00	[4] 400	–	8	–	259	205	464	3	77	2
–	65	18	6	–	282	290	572	3	83	3
270 00	[4] 250	–	24	2 00	911	254	1,165	6	117	4
635 00	113	–	24	3 00	281	193	474	3	62	5
–	388	–	26	–	1,166	14	1,180	6	78	6
1,000 00	300	–	25	–	[5] 1,500	–	1,500	3	77	7
360 00	[4] 111	–	9	–	[5] 660	[5] 285	945	4	338	8
547 50	210	25	24	–	759	287	1,046	5	135	9
75 00	167	2	19	25	256	118	374	5	112	10
150 00	[5] 400	5	21	–	686	38	724	8	56	11
–	72	48	7	–	394	168	562	3	133	12
420 00	125	–	11	129 85	954	15	969	3	80	13
2,520 00	500	–	12	–	1,306	49	1,355	3	63	14
655 00	83	242	27	–	510	294	804	5	72	15
–	[2] –	[2] –	6	–	91	80	171	3	44	16
–	204	80	96	390 25	768	107	875	10	147	17
–	–	–	–	–	–	–	–	–	–	18
665 00	264	69	21	2 00	1,112	445	1,557	6	278	19
556 50	[2] –	[2] –	[2] –	–	340	158	498	4	200	20
100 00	104	41	1	–	372	225	597	3	51	21
675 00	[2] –	[2] –	14	–	345	277	622	3	117	22
–	95	–	10	–	700	536	1,236	5	39	23
720 00	161	5	19	25 00	465	411	876	4	65	24
365 00	147	38	20	75 62	644	818	1,462	5	201	25
–	[2] –	[2] –	16	7 50	470	14	484	3	25	26
1,015 50	265	3	56	821 00	1,688	172	1,860	6	176	27
647 50	249	64	39	187 50	459	289	748	4	70	28
550 00	192	3	43	98 00	652	340	992	4	152	29
800 00	110	43	23	129 00	784	802	1,586	5	145	30
855 00	129	85	31	–	389	69	458	3	55	31
$14,843 50	5,763	771	638	$1,993 97	19,397	6,993	26,190	131	[6] 125	

[4] And gratuities. [5] Estimated. [6] General average of attendance.

DIRECTORY

OF THE

AGRICULTURAL AND SIMILAR ORGANIZATIONS IN MASSACHUSETTS.

APRIL, 1906.

State Board of Agriculture, 1906.

Members ex Officio.

His Excellency CURTIS GUILD, Jr.
His Honor EBEN S. DRAPER.
Hon. WM. M. OLIN, *Secretary of the Commonwealth.*
KENYON L. BUTTERFIELD, M.A., *President Massachusetts Agricultural College (after July 1).*
C. A. GOESSMANN, Ph.D., LL.D., *Chemist of the Board.*
AUSTIN PETERS, M.R.C.V.S., *Chief of the Cattle Bureau.*
ALFRED AKERMAN, M.F., *State Forester.*
J. LEWIS ELLSWORTH, *Secretary of the Board.*

Members appointed by the Governor and Council.

	Term expires
WARREN C. JEWETT of Worcester,	1907
WILLIAM R. SESSIONS of Springfield,	1908
FRANCIS H. APPLETON of Peabody,	1909

Members chosen by the Incorporated Societies.

Amesbury and Salisbury (Agr'l and Hort'l),	J. J. MASON of Amesbury,	1909
Barnstable County,	JOHN BURSLEY of West Barnstable,	1907
Blackstone Valley,	SAMUEL B. TAFT of Uxbridge,	1909
Deerfield Valley,	E. P. WILLIAMS of Ashfield (P. O. Buckland),	1908
Eastern Hampden,	O. E. BRADWAY of Monson,	1909
Essex,	JOHN M. DANFORTH of Lynnfield (P. O. Lynnfield Centre),	1908
Franklin County,	JOHN S. ANDERSON of Shelburne,	1907
Hoosac Valley,	A. M. STEVENS of Williamstown,	1909
Hampshire,	HENRY E. PAIGE of Amherst,	1907
Hampshire, Franklin and Hampden,	WM. A. BAILEY of Northampton,	1909
Highland,	HENRY S. PEASE of Middlefield (P. O. Chester, R. F. D.),	1908
Hillside,	RALPH M. PORTER of Cummington,	1908
Hingham (Agr'l and Hort'l),	EDMUND HERSEY of Hingham,	1909
Housatonic,	EDWIN L. BOARDMAN of Sheffield,	1909
Marshfield (Agr'l and Hort'l),	H. A. OAKMAN of North Marshfield,	1909
Martha's Vineyard,	JOHNSON WHITING of West Tisbury,	1907
Massachusetts Horticultural,	WM. H. SPOONER of Jamaica Plain,	1909
Massachusetts Society for Promoting Agriculture,	N. I. BOWDITCH of Framingham,	1909
Middlesex North,	GEO. W. TRULL[1] of Tewksbury (P. O. Lowell, R. F. D.),	1907
Middlesex South,	ISAAC DAMON of Wayland (P. O. Cochituate),	1908
Nantucket,	H. G. WORTH of Nantucket,	1909
Oxford,	W. M. WELLINGTON of Oxford,	1907
Plymouth County,	AUGUSTUS PRATT of North Middleborough,	1908
Spencer (Far's and Mech's Assoc'n),	H. H. LEACH of North Brookfield (P. O. Spencer),	1907
Union (Agr'l and Hort'l),	ALBERT H. NYE of Blandford (P. O. Russell),	1907
Weymouth (Agr'l and Ind'l),	QUINCY L. REED of South Weymouth,	1909
Worcester,	WALTER D. ROSS of Worcester,	1908
Worcester East,	W. A. KILBOURN of South Lancaster,	1909
Worcester Northwest (Agr'l and Mech'l),	ALBERT ELLSWORTH of Athol,	1907
Worcester South,	C. D. RICHARDSON of West Brookfield,	1907
Worcester County West,	J. HARDING ALLEN of Barre,	1908

[1] Successor of Mr. Henry S. Perham, who died February 25.

ORGANIZATION OF THE BOARD.

OFFICERS.

President, . .	His Excellency CURTIS GUILD, Jr., *ex officio*.
1st Vice-President,	WILLIAM R. SESSIONS of Springfield.
2d Vice-President, .	AUGUSTUS PRATT of North Middleborough.
Secretary, . .	J. LEWIS ELLSWORTH of Worcester.

Office, Room 136, State House, Boston.

COMMITTEES.

Executive Committee.

Messrs. W. A. Kilbourn of South Lancaster.
John Bursley of West Barnstable.
Wm. H. Spooner of Boston.
Francis H. Appleton of Peabody.
Augustus Pratt of North Middleborough.
C. D. Richardson of West Brookfield.
Edmund Hersey of Hingham.
Henry S. Perham of Chelmsford.[1]

Committee on Agricultural Societies.

Messrs. W. A. Kilbourn of South Lancaster.
Q. L. Reed of South Weymouth.
O. E. Bradway of Monson.
J. Harding Allen of Barre.
Albert Ellsworth of Athol.

Committee on Domestic Animals and Sanitation.

Messrs. Henry S. Perham of Chelmsford.[1]
Johnson Whiting of West Tisbury.
John S. Anderson of Shelburne.
Henry E. Paige of Amherst.
A. M. Stevens of Williamstown.

Committee on Gypsy Moth, Insects and Birds.

Messrs. Augustus Pratt of North Middleborough.
J. M. Danforth of Lynnfield.
W. C. Jewett of Worcester.
H. H. Leach of North Brookfield.
Walter D. Ross of Worcester.

Committee on Dairy Bureau and Agricultural Products.

Messrs. C. D. Richardson of West Brookfield.
J. M. Danforth of Lynnfield.
Henry E. Paige of Amherst.
W. M. Wellington of Oxford.
S. B. Taft of Uxbridge.

Committee on Massachusetts Agricultural College.

Messrs. John Bursley of West Barnstable.
W. C. Jewett of Worcester.
Isaac Damon of Wayland.
A. H. Nye of Blandford.
E. L. Boardman of Sheffield.

Committee on Experiments and Station Work.

Messrs. Wm. H. Spooner of Boston.
N. I. Bowditch of Framingham.
Ralph M. Porter of Cummington.
E. P. Williams of Ashfield.
H. A. Oakman of Marshfield.

Committee on Forestry, Roads and Roadside Improvements.

Messrs. Francis H. Appleton of Peabody.
H. G. Worth of Nantucket.
J. J. Mason of Amesbury.
Henry S. Pease of Middlefield.
W. M. Wellington of Oxford.

Committee on Institutes and Public Meetings.

Messrs. Edmund Hersey of Hingham.
Geo. W. Trull of Tewksbury.
Wm. R. Sessions of Springfield.
Wm. A. Bailey of Northampton.
Kenyon L. Butterfield of Amherst.

The secretary is a member, *ex officio*, of each of the above committees.

[1] Died Feb. 25, 1906.

DAIRY BUREAU.

Messrs. C. D. RICHARDSON of West Brookfield, 1908; HENRY E. PAIGE of Amherst, 1906; J. M. DANFORTH of Lynnfield, 1907.

Executive Officer, ... J. L. ELLSWORTH.
General Agent, ... P. M. HARWOOD of Barre.

STATE NURSERY INSPECTOR.

HENRY T. FERNALD, Ph.D., of Amherst.

SPECIALISTS.

By Election of the Board.

Chemist, ...	Dr. C. A. GOESSMANN, ...	Amherst.
Entomologist, ...	Prof. C. H. FERNALD, ...	Amherst.
Botanist, ...	Dr. GEO. E. STONE, ...	Amherst.
Pomologist, ...	Prof. F. A. WAUGH, ...	Amherst.
Veterinarian, ...	Prof. JAMES B. PAIGE, ...	Amherst.
Engineer, ...	WM. WHEELER, ...	Concord.
Ornithologist, ...	E. H. FORBUSH, ...	Wareham.

By Appointment of the Secretary.

Librarian, F. H. FOWLER, B.Sc., *First Clerk*.

MASSACHUSETTS AGRICULTURAL COLLEGE.

Location, Amherst, Hampshire County.

Board of Trustees.	Term expires
J. Howe Demond of Northampton,	1907
Elmer D. Howe of Marlborough,	1907
Nathaniel I. Bowditch of Framingham,	1908
William Wheeler of Concord,	1908
Arthur G. Pollard of Lowell,	1909
Charles A. Gleason of Springfield,	1909
James Draper of Worcester,	1910
Samuel C. Damon of Lancaster,	1910
Merritt I. Wheeler of Great Barrington,	1911
Charles W. Preston of Danvers,	1911
Carroll D. Wright of Worcester,	1912
M. Fayette Dickinson of Boston,	1912
William H. Bowker of Boston,	1913
George H. Ellis of Newton,	1913

Members ex Officio.

His Excellency Governor Curtis Guild, Jr.,
President of the Corporation.

Kenyon L. Butterfield, M.A.,	*President of the College.*[1]
George H. Martin,	*Secretary of the Board of Education.*
J. Lewis Ellsworth,	*Secretary of the Board of Agriculture.*

Officers elected by the Board of Trustees.

Charles A. Gleason of Springfield,	*Vice-President of the Corporation.*
J. Lewis Ellsworth of Worcester.	*Secretary.*
Prof. George F. Mills of Amherst,	*Treasurer.*
Charles A. Gleason of Springfield,	*Auditor.*
Kenyon L. Butterfield, M.A.,	*President of the College.*[1]

Board of Overseers.

The State Board of Agriculture.

Examining Committee of the Board of Agriculture.

Messrs. Bursley, Jewett, Damon, Nye and Boardman.

Hatch Experiment Station of the Massachusetts Agricultural College.

Wm. P. Brooks, Ph.D.,	*Agriculturist and Director.*
F. A. Waugh, B.Sc.,	*Horticulturist.*
Charles H. Fernald, Ph.D.,	*Entomologist.*
Henry T. Fernald, Ph.D.,	*Assistant Entomologist.*
Chas. A. Goessmann, Ph.D.,	*Chemist* (Fertilizers).
Joseph B. Lindsey, Ph.D.,	*Chemist* (Foods and Feeding).
George E. Stone, Ph.D.,	*Botanist.*
J. E. Ostrander, C.E.,	*Meteorologist.*

---

[1] Prof. Wm. P. Brooks Acting President to July 1.

Agricultural Societies incorporated by Special Act of the Legislature, and represented on the Board of Agriculture.

NAME.	PRESIDENT.	SECRETARY.	TREASURER.
Amesbury and Salisbury,[1]	Daniel Webster, Amesbury.	Edward W. George, Amesbury.	N. E. Collins, Amesbury.
Barnstable County,	Dr. Gorham Bacon, Yarmouth.	M. N. Harris, Barnstable.	A. F. Sherman, Barnstable.
Blackstone Valley,	Samuel B. Taft, Uxbridge.	Dr. M. R. Sharpe, Uxbridge.	Dr. M. R. Sharpe, Uxbridge.
Deerfield Valley,	W. B. Avery, Charlemont.	S. W. Hawkes, Charlemont.	E. F. Haskins, Charlemont.
Eastern Hampden,	O. E. Bradway, Monson.	L. E. Chandler, Palmer.	W. L. Shaw, Palmer.
Essex,	Fred'k A. Russell, Methuen.	J. M. Danforth, Lynnfield.	W. S. Nichols, Salem.
Franklin County,	Chas. T. Aldrich, Greenfield.	Henry J. Field, Greenfield.	Frank H. Snow, Greenfield.
Hampshire,	Dr. Henry E. Paige, Amherst.	S. J. Reed, Amherst.	S. J. Reed, Amherst.
Hampshire, Franklin and Hampden.	Frank P. Newkirk, Easthampton.	C. A. Montgomery, Northampton.	C. A. Montgomery, Northampton.
Highland,	Henry E. Stanton, Huntington.	J. T. Bryan, Middlefield.	M. J. Smith, Middlefield.
Hillside,	H. A. Ford, Windsor.	C. F. Burr, Ringville.	D. E. Lyman, Cummington.
Hingham,[1]	Geo. E. Kimball, Hingham.	William H. Thomas, Hingham.	Reuben Sprague, Hingham.
Hoosac Valley,	Dr. F. D. Safford, North Adams.	Gilbert Maxwell, North Adams.	M. R. Ford, North Adams.
Housatonic,	Frank W. Heath, Stockbridge.	Fred J. Fuller, Great Barrington.	A. C. Collins, Great Barrington.
Marshfield,[1]	Thomas W. Lawson, Boston.	I. H. Hatch, North Marshfield.	M. H. Kent, Marshfield.
Martha's Vineyard,	B. T. Hillman, Edgartown.	F. A. Look, West Tisbury.	Geo. H. Luce, West Tisbury.
Massachusetts Horticultural,	Arthur F. Estabrook, Boston.	Wm. P. Rich, Boston.	C. E. Richardson, Brookline.
Massachusetts Society for Promoting Agriculture.	C. S. Sargent, Brookline.	Francis H. Appleton, Peabody.	R. M. Saltonstall, Newton.
Middlesex North,	Arthur H. Cluer, Lowell.	Andrew Liddell, Lowell.	John A. Weinbeck, Lowell.
Middlesex South,	Charles F. Parsons, Framingham.	O. O. Davis, South Framingham.	George E. Fay, Framingham.
Nantucket,	H. G. Worth, Nantucket.	J. F. Murphey, Nantucket.	Asa C. Jones, Nantucket.
Oxford,	E. N. Bartlett, North Oxford.	J. E. Darling, Oxford.	J. E. Darling, Oxford.
Plymouth County,	Augustus Pratt, North Middleborough.	J. Herbert Leonard, Bridgewater.	J. Herbert Leonard, Bridgewater.

[1] And horticultural.

Agricultural Societies, etc. — *Concluded.*

NAME.	PRESIDENT.	SECRETARY.	TREASURER.
Spencer Farmers' and Mechanics' Association.	E. H. Stoddard, East Brookfield.	Geo. H. Ramer, Spencer.	Geo. H. Ramer, Spencer.
Union,[1]	C. B. Hayden, Blandford.	E. W. Boise, Blandford.	Geo. O. Millard, Blandford.
Weymouth (Ag'l and Ind.),	W. W. Castle, East Weymouth.	T. L. Tirrell, South Weymouth.	E. J. Pitcher, South Weymouth.
Worcester,	Ledyard Bill, Paxton.	Mrs. M. M. Hastings, Worcester.	L. F. Herrick, Worcester.
Worcester East,	John E. Thayer, Lancaster.	Warren Goodale, Clinton.	Lucius Field, Clinton.
Worcester Northwest (Agricultural and Mechanical).	Dr. James Oliver, Athol Centre.	Albert Ellsworth, Athol.	E. L. Worrick, Athol.
Worcester South,	Geo. L. Clemence, Southbridge.	C. V. Corey, Sturbridge.	C. V. Corey, Sturbridge.
Worcester County West,	Geo. H. Ellis, West Newton.	Matthew Walker, Barre.	M. H. Bacon, Barre.

[1] And horticultural.

Horticultural Societies.

NAME.	LOCATION.	PRESIDENT.	SECRETARY.
Cape Ann,	Gloucester,	Bennett Griffith, Gloucester.	Wm. D. Lufkin, Gloucester.
Haverhill,	Haverhill,	Walter Goodrich, Haverhill.	Mrs. William M. Webster, Haverhill.
Hampden County,	Springfield,	Jacob C. Lutz, Springfield.	William F. Gale, Springfield.
Houghton,	Lynn,	Samuel T. Stewart, Lynn.	Miss Ruth S. Wood, Lynn.
Lenox,	Lenox,	S. Carlquist, Lenox.	George Foulsham, Lenox.
Massachusetts,	The State,	Arthur F. Estabrook, Boston.	Wm. P. Rich, Boston.
North Shore,	Manchester,	James McGregor, Manchester.	James Salter, Manchester.
Springfield Amateur,	Springfield,	W. T. Hutchins, Indian Orchard.	Chas. L. Burr, Springfield.
Worcester County,	Worcester,	O. B. Hadwen, Worcester.	Adin A. Hixon, Worcester.

Farmers' and Mechanics' Associations.

Bolton,	Bolton,	Legrand F. Brigham, Bolton.	William M. Brigham, Bolton.
Needham,	Needham,	Samuel Watts, Natick.	Richmond Favor, Natick.
Oakham,	Oakham,	Wm. Parkman, Oakham.	John P. Day, Jr., Oakham.
Princeton,	Princeton,	J. C. F. Mirick, Princeton.	J. E. Merriam, Princeton.
Westminster,	Westminster,	C. F. Giles, Westminster.	O. L. Stone, Westminster.

Farmers' and Mechanics' Clubs.

Ashburnham,	Ashburnham,	E. J. Forristall, South Ashburnham.	W. E. Jefts, Ashburnham.
Ashby,	Ashby,	W. O. Loveland, Ashby.	W. J. Smith, Ashby.
Belchertown,	Belchertown,	D. F. Shumway, Belchertown.	- -
Groton,	Groton,	Wm. A. Lawrence, Groton.	L. H. Sheedy, Groton.
Holden,	Holden,	Levi H. Howe, Holden.	Mrs. H. J. Jones, Holden.
Pepperell,	Pepperell,	L. Adelbert Boynton, Pepperell.	Frank T. Marston, Pepperell.
Shirley,	Shirley,	H. S. Hazen, Shirley Centre.	M. W. Longley, Shirley Centre.
Shrewsbury,	Shrewsbury,	E. A. Bartlett, Shrewsbury.	F. J. Stone, Shrewsbury.

Farmers' Clubs.

NAME.	LOCATION.	PRESIDENT.	SECRETARY.
Boxborough,	Boxborough,	R. Y. Nelson, Boxborough.	G. W. Burroughs, Boxborough.
Buckland,	Buckland,	W. S. Williams, Buckland.	W. D. Forbes, Shelburne Falls.
Chamberlain District,	Worcester,	Pliny Moore, Worcester.	S. A. Burgess, Worcester.
East Charlemont,	East Charlemont,	W. W. Smith, East Charlemont.	Geo. H. Wheeler, East Charlemont.
Easthampton,	Easthampton,	E. H. Clark, Easthampton.	C. W. Smith, Easthampton.
Franklin,	Franklin,	Edward S. Cook, Franklin.	Fred M. Thayer, Franklin.
Halifax,	Halifax,	Jas. T. Thomas, Halifax.	Mrs. Geo. W. Hayward, Halifax.
Lancaster,	Lancaster,	George F. Morse, South Lancaster.	F. A. Hanaford, South Lancaster.
New Braintree,	New Braintree,	D. C. Wetherell, New Braintree.	Chas. S. Lane, New Braintree.
Rehoboth,	Rehoboth,	Dr. C. N. Raymond, Rehoboth.	Wm. H. Gladding, Rehoboth.
Rowley,	Rowley,	J. D. Dodge, Rowley.	T. P. Hale, Rowley.
South Bristol,	New Bedford,	Franklyn Howland, Acushnet.	Allen Russell, Jr., Acushnet.
Tatnuck,	Worcester,	L. J. Kendall, Worcester.	H. Ward Moore, Worcester.
Upton,	Upton,	Appleton P. Williams, Upton.	Geo. Z. Williams, Upton.
West Brookfield,	West Brookfield,	Albert B. Patrick, Warren.	Sumner H. Reed, West Brookfield.
West Newbury,	West Newbury,	Samuel O. Ordway, West Newbury.	Parker H. Nason, West Newbury.
Wilbraham,	Wilbraham,	B. F. Green, North Wilbraham.	H. M. Bliss, R. F. D. 2, Ludlow.

Poultry Associations.

Amesbury Poultry and Pet Stock Association.	Amesbury,	W. E. Tibbetts, Amesbury.	M. H. Sands, Amesbury.
Athol Poultry and Pet Stock Association,	Athol,	- -	J. E. Burt, Athol.
Brockton Poultry Association,	Brockton,	M. E. Holmes, Campello.	C. A. Brown, Brockton.
Essex County Poultry Association,	Beverly,	E. A. Morrow, Salem.	Daniel P. Foster, North Beverly.
Falmouth Poultry Association,	Falmouth,	E. P. Davis, Falmouth.	R. E. Small, Falmouth.
Fitchburg Poultry and Pet Stock Association.	Fitchburg,	Frank A. Wood, Fitchburg.	J. Lee Frost, Fitchburg.
Greenfield Score Card Poultry Club,	Greenfield,	H. M. Woodward, Greenfield.	F. L. Gaines, Greenfield.
Lawrence Poultry and Pet Stock Association.	Lawrence,	B. D. Todd, Lawrence.	Asa L. Harris, Lawrence.
Lynn Poultry Association,	Lynn,	J. Fred Bessom, Lynn.	Chas. E. Hunt, Lynn.
Milford Poultry Association,	Milford,	J. E. Nolan, Milford.	W. H. Pyne, Milford.
New Bedford Poultry Association,	New Bedford,	Jas. B. Hamlin, Acushnet.	Norman Barstow, New Bedford.
North Abington Poultry Association,	North Abington,	Chas. W. Pratt, North Abington.	Jas. H. Dwyer, North Abington.
Northampton Poultry Association,	Northampton,	C. E. Hodgkins, Northampton.	C. L. Gallup, Northampton.
Plymouth Poultry Association,	Plymouth,	T. Allen Bagnell, Plymouth.	F. C. Chandler, Kingston.
Springfield Poultry and Pet Stock Association.	Springfield,	E. C. Powell, Longmeadow.	E. S. Evans, Springfield.
West Brookfield Poultry Association,	West Brookfield,	R. H. Bullington, West Brookfield.	E. L. Richardson, West Brookfield.

Miscellaneous.

NAME.	LOCATION.	PRESIDENT.	SECRETARY.
Bay State Agricultural Society,	The State,	C. Minot Weld, Boston.	N. I. Bowditch, Framingham.
Boston Market Gardeners' Association,	Boston and vicinity,	W. W. Rawson, Arlington.	J. B. Shurtleff, Jr., Revere.
Brockton Agricultural Society,	Brockton,	Hon. H. W. Robinson, Brockton.	Baalis Sanford, Brockton.
Cranberry Growers' Association,	Cape Cod District,	George R. Briggs, Plymouth.	Wm. M. Marsh, Wareham.
Franklin Harvest Club,	Connecticut Valley,	C. R. Hills, Bernardston.	C. B. Lyman, Southampton.
Hampden Agricultural Society,	Springfield,	C. W. Bemis, Longmeadow.	E. S. Batchelder, Springfield.
Hampden Harvest Club,	Connecticut Valley,	The members alternately.	Henry M. Taylor, Easthampton.
Massachusetts Cattle Owners' Association,	The State,	S. C. Dresser, Westborough.	J. L. Harrington, Lunenburg.
Massachusetts Creamery Association,	The State,	W. H. Wright, Easthampton.	A. M. Lyman, Montague.
Massachusetts Forestry Association.	The State,	Dr. Henry P. Walcott, Cambridge.	Edwin A. Start, Boston.
Massachusetts Fruit Growers' Association,	The State,	Jonathan Eames, Sherborn.	S. T. Maynard, Northborough.
Wakefield-Reading Fair Company,	Wakefield,	George A. Shackford, Reading.	B. F. Calley, Jr., Wakefield.
Ware Agricultural Society,	Ware,	F. F. Gilmore, Ware.	E. P. Lovett, Ware.
Worcester County Harvest Club,	Worcester,	B. W. Potter, Worcester.	Mrs. W. C. Jewett, Worcester.
Worcester County Bee-keepers' Association,	Worcester,	Burton N. Gates, Worcester.	C. R. Russell, Worcester.
Worcester North Agricultural Society,	Fitchburg,	H. O. Mead, Lunenburg.	W. H. Laws, Ashburnham.

MASSACHUSETTS PATRONS OF HUSBANDRY.

Officers of the State Grange, 1906.

Master,	Carlton D. Richardson of West Brookfield.
Overseer,	John E. Gifford of Brockton.
Lecturer,	Charles M. Gardner of Westfield.
Steward,	C. C. Colby of Hubbardston.
Assistant Steward,	C. O. Littlefield of Sherborn.
Chaplain,	Rev. A. H. Wheelock of Pepperell.
Treasurer,	Hon. F. A. Harrington of Worcester.
Secretary,	Wm. N. Howard of South Easton.
Gate Keeper,	I. H. Lamb of Stoughton.
Ceres,	Mrs. Ida Coleman of Richmond.
Pomona,	Mrs. Nellie S. Stevens of Wellesley.
Flora,	Mrs. Ida I. Beals of Winchendon.
Lady Assistant Steward,	Mrs. S. Mabel Thompson of Hopkinton.

Executive Committee.

C. A. Dennen,	Pepperell.
George L. Clemence,	Southbridge.
George S. Ladd,	Sturbridge.

General Deputies.

James Draper,	Worcester.
N. B. Douglas,	Sherborn.
E. D. Howe,	Marlborough.
W. C. Jewett,	Worcester.
G. S. Ladd,	Sturbridge.
A. C. Stoddard,	North Brookfield.
Herbert Sabin,	Amherst.

Pomona Deputies.

Hon. M. A. Morse,	Belchertown.
W. E. Patrick,	Warren.
Mrs. S. Ella Southland,	Athol Centre.

Subordinate Grange Deputies.

C. H. Shaylor,	Lee.
Henry N. Jenks,	Cheshire.
W. A. Harlow,	Cummington.
F. L. Warfield,	Buckland.
E. B. Hale,	Bernardston.
C. R. Damon,	Williamsburg.
L. R. Smith,	Hadley.
E. E. Chapman,	Ludlow.
Geo. W. Sherman,	Brimfield.
C. A. Stimson,	Royalston.
W. H. Sawyer,	Winchendon.
T. E. Flarity,	Townsend.
E. H. Gilbert,	North Easton.

SUBORDINATE GRANGE DEPUTIES — *Con.*

Moses Gaskill,	Mendon.
L. H. Cudworth,	Oxford.
E. F. Richardson,	Millis.
Elbridge Noyes,	Newbury.
Geo. E. Crosby,	Lowell.
John Bursley,	West Barnstable.
G. W. Wasson,	Haverhill.

SPECIAL DEPUTIES.

John E. Gifford,	Sutton.
Wm. N. Howard,	South Easton.
G. C. Sevey,	Springfield.
W. T. Herrick,	Westborough.

COMMITTEE ON LADIES' WORK.

Mrs. D. P. Bardwell,	Bardwell's Ferry.
Mrs. Geo. S. Ladd,	Sturbridge.
Mrs. H. E. Cummings,	North Brookfield.
Mrs. T. E. Flarity,	Townsend.

Massachusetts Patrons of Husbandry — *Continued.*

NAME.	MASTER.	LECTURER.	SECRETARY.
Pomona Granges.			
Middlesex and Norfolk, No. 1,	George P. Holbrook, Millis.	Edward Grover, Walpole.	Mrs. Alice Duprez, Franklin.
Essex County, No. 2,	Ira J. Webster, Haverhill.	Mrs. Elizabeth M. Newell, West Newbury.	Miss Matilda B. Lund, West Boxford.
Middlesex-Worcester, No. 3,	Frank T. Marston, East Pepperell.	Mrs. D. W. Mason, Ayer.	Mrs. Minnie L. F. Knight, Townsend Harbor.
Franklin and Worcester, No. 4,	Mrs. S. Ella Southland, Athol.	George A. Witherell, Warwick.	A. J. Hastings, Orange, R. F. D.
Worcester West, No. 5,	Harry E. Murdock, East Hubbardston.	Mrs. Lizzie J. Patterson, Barre.	Mrs. Eva S. Moore, Hubbardston.
Berkshire County, No. 6,	Robert Coleman, Pittsfield, R. F. D.	Wesley B. Barton, Pittsfield.	Mrs. Nina P. Morse, Dalton.
Worcester Central, No. 7,	Fred Midgeley, Worcester.	Mrs. C. H. Freeman, Worcester.	Mrs. Ellen M. Hayward, Millbury.
Hampshire County, No. 8,	Charles R. Damon, Williamsburg.	Mrs. Dwight Clary, Williamsburg.	Mrs. M. A. Ward, South Deerfield, R. F. D.
Worcester Southwest, No. 9,	Mrs. Mary O. Lakin, Brookfield, R. F. D.	Harry S. Shepard, Globe Village.	Mrs. Mary Q. Ainsworth, E. Brookfield.
Worcester and Norfolk, No. 10,	Moses U. Gaskill, Mendon.	William P. Greenwood, Milford.	A. W. Gaskill, Mendon.
Borough, No. 11,	John K. Mills, Northborough, R. F. D.	Mrs. S. Mabel Thompson, Westborough, R. F. D.	Mrs. Maria A. Gilmore, Westborough, R. F. D.
Springfield, No. 12,	Chas. B. Bennett, Ludlow.	Mrs. A. C. Barker, Springfield.	Mrs. C. L. Hayward, Agawam.
Old Colony, No. 13,	Joseph W. Baldwin, North Easton.	Mrs. Louisa Carpenter, Attleborough.	Mrs. Alida N. Stevens, South Braintree.
Worcester East, No. 14,	Mrs. Ella D. Rice, Leominster.	Joseph K. Killbourn, Sterling.	Mrs. Ida. A. Cunningham, Lancaster.
Quaboag, No. 15,	J. P. Ranger, North Brookfield.	A. C. Stoddard, North Brookfield.	Carrie A. Smith, West Brookfield.
Middlesex North, No. 16,	C. F. K. Bancroft, Tyngsborough.	George P. Greenwood, South Billerica.	Mrs. Mabel H. Peavey, Lowell, R. F. D.
Deerfield Valley, No. 17,	A. P. Goldthwait, Rowe.	Mrs. D. P. Bardwell, Bardwell's Ferry.	Miss Mary C. Burrington, Heath.
Western Hampden, No. 18,	N. J. Trench, Southwick.	C. M. Gardner, Westfield.	Annette Sackett, Westfield.
Connecticut Valley, No. 19,	E. B. Hale, Bernardston.	Miss Martha Sprague, Greenfield.	Mrs. Emma L. Barton, Riverside.
Hillside, No. 20,	W. A. Harlow, Cummington.	Perley Skelton, Worthington.	Mrs. A. R. Tirrell, Plainfield.

MASSACHUSETTS PATRONS OF HUSBANDRY — *Continued.*

NAME.	MASTER.	LECTURER.	SECRETARY.
Subordinate Granges.			
"Guiding Star" of Greenfield, No. 1.	John W. Bragg, Greenfield.	Mrs. Matthew Barber, Greenfield.	Raymond F. Cowan, Greenfield.
Deerfield, No. 2,	Rev. Richard E. Birks, Deerfield.	Miss Nellie Birks, Deerfield.	P. G. Davis, Deerfield.
Northfield, No. 3,	Henry H. Mason, Northfield.	Mrs. M. T. Moore, Northfield.	Mrs. T. R. Callender, Northfield.
Groton, No. 7,	Daniel W. Mason, Ayer.	Miss Rosa A. Adams, Groton.	Ella P. Woolley, Groton.
Conway, No. 8,	Chas. F. Elmer, Conway.	Earl Miller, Conway.	Miss Anna L. Hopkins, Conway.
Barre, No. 9,	Edwin C. Hunt, Barre.	John L. Smith, Barre.	J. M. Washburn, Barre.
"Hope" of Hadley, No. 15,	John W. Marsh, Hadley.	Mrs. L. W. West, Hadley.	Mrs. Henry Edson Smith, Hadley.
Amherst, No. 16,	Andrew G. Sydell, Amherst.	Mrs. E. E. Perry, Amherst.	Mrs. T. E. Brigham, Amherst.
Cheshire, No. 17,	H. Arthur Martin, Cheshire.	Mrs. Maude L. Purdy, Cheshire.	Jabez C. Jenks, Adams, R. F. D.
Hinsdale, No. 19,	C. E. Robinson, Hinsdale.	T. F. Barker, Hinsdale.	Mrs. Wm. A. Watkins, Hinsdale.
Westfield, No. 20,	Ernest R. Post, Westfield.	Anna K. Root, Westfield.	Annette Sackett, Westfield.
Lanesborough, No. 21,	Arthur E. Simmons, Lanesborough.	Miss Eunice J. Tillottson, Lanesborough.	Miss Ella A. Miner, Lanesborough.
Worcester, No. 22,	Willis E. Cary, Worcester.	Mrs. George E. Bowen, Worcester.	Mrs. Chas. W. Moore, Worcester.
Dalton, No. 23,	James Bardin, Dalton.	Herbert B. Brown, Dalton.	Miss Bertha A. Dodge, Dalton.
Blandford, No. 24,	W. V. Bodurtha, Blandford, R. F. D.	George Emmons, Russell.	Miss Hattie Emmons, Russell.
New Lenox, No. 26,	Mrs. E. A. Howland, New Lenox.	Mrs. Eugene Mattoon, New Lenox.	Luther Sears, New Lenox.
Easthampton, No. 27,	Walter Bartlett, Easthampton.	Mrs. Geo. Porter, Easthampton.	Mrs. Lyman Dibble, Easthampton.
Richmond, No. 32,	W. O. Wheeler, Richmond, R. F. D.	Miss Anna Medlyn, Richmond, R. F. D.	Mrs. Ida B. Coleman, Pittsfield, R. F. D.
Adams, No. 34,	Chas. A. Daniels, Adams.	Mrs. Charles O. Gould, Adams.	Miss Ora Dudley, Adams.
Granville, No. 40,	H. B. Dickinson, Granville.	L. F. Henry, Granville.	Mrs. I. L. Gibbons, Granville.
Montgomery, No. 45,	A. J. Hall, Montgomery.	L. O. Moore, Montgomery.	Miss Florence Moore, Montgomery.
Southwick, No. 46,	Frank D. Lambson, Southwick.	Mrs. C. G. Stone, Southwick.	Mrs. W. P. Griffin, Southwick.
Becket, No. 47,	Clinton M. Capen, Becket.	Rev. Geo. M. Jones, Becket.	Albert E. Roger, Becket.
Highland, No. 48,	Edwin F. Goodwin, Littleville.	Mrs. Belle S. Wilbur, Huntington.	Bertha M. Kelso, Huntington.
"Granite" of South Worthington, No. 49.	Reuben Drake, Ringville.	Mrs. Nina Higgins, Ringville.	Mrs. Emma Thrasher, South Worthington.
Sterling, No. 53,	Joseph R. Graham, Pratts Junction.	Fred R. Trask, Pratt's Junction.	Louis A. Stuart, Pratt's Junction.

Springfield, No. 54,	George N. Merrill, Springfield.	Mrs. Carrie T. Littlefield, Springfield.	Mrs. Belle Barney, Springfield.
Cummington, No. 56,	E. B. Streeter, Cummington.	Rollin Bates, Swift River.	C. A. Stevens, Cummington.
Auburn, No. 60,	William E. Barrows, Auburn.	Mrs. C. H. Freeman, Worcester.	H. J. Marcy, Auburn.
"Union" of Belchertown, No. 64,	Arthur E. Pease, Belchertown.	Mrs. M. G. Ward, Belchertown.	Mrs. H. H. Ward, Belchertown.
Brimfield, No. 65,	R. V. Sawin, Brimfield.	Clarence W. King, Brimfield.	Mrs. B. A. Garms, Brimfield.
Charlemont, No. 66,	D. J. Davenport, Charlemont.	Mrs. D. P. Bassett, Charlemont.	T. M. Totman, Charlemont.
Hardwick, No. 67,	C. H. Prouty, Furnace.	Mrs. J. S. Hillman, Hardwick.	Mrs. Mabel M. Emmons, Hardwick.
Shelburne, No. 68,	D. P. Bardwell, Bardwell's Ferry.	Mrs. D. P. Bardwell, Shelburne.	Ira L. Barnard, Shelburne.
Ashfield, No. 69,	Harlan P. Howes, Spruce Corner.	Mrs. Herbert Clark, Ashfield.	Mrs. Maud C. Dyer, Ashfield.
Phillipston, No. 70,	D. Webster Baker, Athol, R. F. D.	Mrs. Mary R. Chaflin, Phillipston.	Mrs. Cora A. Dunton, Athol.
Leyden, No. 71,	Edwin P. Howes, Leyden.	Mrs. Will Campbell, Greenfield.	Mrs. Fred A. Wright, Leyden.
"Prescott" of Pepperell, No. 73,	Fred O. Parker, Pepperell.	Miss Lucy E. Blood, Pepperell.	Miss S. Luella Parker, East Pepperell.
Colrain, No. 76,	S. E. Temple, Shattuckville.	Mrs. E. M. Dwight, Griswoldville.	William M. Stacy, Shelburne Falls.
Windsor, No. 77,	Addison E. Miner, East Windsor.	Mrs. Josephine Miner, East Windsor.	Mrs. Belle D. Miner, East Windsor.
Holden, No. 78,	Chas. S. Graham, Holden, R. F. D.	Mrs. Nattie Bemis, Holden.	Miss Florence E. Graham, Jefferson.
Spencer, No. 79,	Mrs. C. J. Sibley, Spencer.	Mrs. Emma Lynde, Spencer.	J. W. Bigelow, Spencer.
Bernardston, No. 81,	Myron L. Corbett, Bernardston.	Mrs. R. H. Cushman, Bernardston.	Mrs. E. B. Hale, Bernardston.
"Manhan" of Southampton, No. 82.	C. S. Hooker, Holyoke.	Mrs. Elmina Gilbert, Southampton.	Mrs. C. P. Gridley, Southampton.
Warwick, No. 85,	Geo. A. Witherell, Warwick.	Mrs. Etta M. T. Bass, Warwick.	A. J. Hastings, Orange.
North Orange, No. 86,	Rollin O. White, North Orange.	Mrs. Hattie M. Baker, North Orange.	A. M. White, North Orange.
Buckland, No. 87,	H. B. Wells, Shelburne Falls.	Mrs. Inez King, Shelburne Falls.	H. E. Ward, Shelburne Falls.
Lee, No. 88,	C. G. Hinckley, Lee.	Alonzo Bradley, Lee.	Mrs. W. M. Shaylor, Lee.
Worthington, No. 90,	Perley A. Skelton, Cummington, R. F. D.	Miss Nellie C. Shipman, West Worthington.	Mrs. Clarence K. Bates, Cummington.
Charlton, No. 92,	Josephine A. Balcome, Dodge, R. F. D.	William Casey, Charlton Depot.	Rosa E. Bowers, Charlton Depot.
Grafton, No. 93,	J. Frank Johnson, North Grafton.	Lyman M. Rice, North Grafton.	Mrs. Mary G. Rice, North Grafton.
Petersham, No. 95,	Geo. K. Wilder, Petersham.	Rev. Preston R. Crowell, Petersham.	Miss Ethel Hill, Petersham.
Savoy, No. 99,	F. N. Haskins, Savoy.	Mrs. G. J. Walker, Savoy Centre.	L. E. Flanders, Savoy.
Shrewsbury, No. 101,	George E. Brigham, Shrewsbury.	William E. Rice, Shrewsbury.	Fred H. Goddard, Shrewsbury.
Stow, No. 103,	Roland P. Harriman, Maynard.	Mrs. Carrie L. Smith, Stow.	Mrs. Nancy S. Lewis, West Acton, R. F. D.
"Garfield" of No. Dana, No. 104,	Lyman Randall, North Dana.	E. A. Collier, North Dana.	Louis A. Pratt, North Dana.
Marlborough, No. 105,	E. N. Stratton, Marlborough.	Mrs. Maud M. Kallom, Marlborough.	B. Frank Hatstat, Marlborough.

MASSACHUSETTS PATRONS OF HUSBANDRY — *Continued.*

NAME.	MASTER.	LECTURER.	SECRETARY.
Millbury, No. 107,	Edward P. Davison, West Millbury.	Mrs. Vera A. Converse, Millbury.	Miss Susan A. Hayward, Millbury.
Hudson, No. 108,	W. R. Coolidge, Hudson.	Miss J. Marie Jensen, Hudson.	Mrs. Mary E. Laurence, Hudson.
Sutton, No. 109,	R. H. Richardson, Sutton, R. F. D.	James W. Stockwell, Sutton.	Miss Sarah M. Mills, Sutton, R. F. D.
Sherborn, No. 110,	John N. Reid, Sherborn.	Mrs. M. A. Whitney, South Framingham, R. F. D.	Miss Annie H. Daniels, South Sherborn.
Boylston, No. 111,	Munson C. Flagg, Boylston Centre.	Mrs. Henrietta M. Andrews, Boylston Centre.	Mrs. Angeline B. Brouseau, Boylston Centre.
East Medway, No. 112,	Clarence E. Simpson, Millis.	E. F. Lovell, Millis.	Ethel B. Henderson, Millis.
Framingham, No. 113,	David E. Stone, Framingham.	Mrs. A. H. Wood Framingham.	Arthur H. Patch, South Framingham.
Medfield, No. 114,	A. H. Clark, Medfield.	Mrs. Emma Damrell, Westwood.	Mrs. W. W. Preston, Medfield.
Holliston, No. 115,	Albert W. Littlefield, Holliston.	Ernest Herrock, Holliston.	Mrs. Nellie V. Pope, Holliston.
Westborough, No. 116,	J. A. Gilmore, Westborough, R. F. D.	William T. Herrick, Westborough.	Mrs. Julia H. Rogers, Westborough.
Dover, No. 117,	James H. Chickering, Dover.	Mrs. I. M. Packard, Needham.	Mrs. E. A. Wotton, Dover.
Southborough, No. 118,	Charles. E. Taylor, Ashland, R. F. D.	Mrs. John T. Gibson, Southborough.	Waldo A. Fay, Southborough.
Northborough, No. 119,	Wm. W. Warren, Northborough.	Mrs. Delia F. Corey, Northborough.	Mrs. Mary E. Mentzer, Northborough.
Lancaster, No. 120,	J. Fred Brown, South Lancaster.	Andrew J. Kennedy, Lancaster.	Miss Mary B. Evans, Clinton.
Sudbury, No. 121,	Roy A. Whitney, Maynard, R. F. D.	T. F. O'Neill, North Sudbury.	Mrs. Ida J. Rice, Maynard, R. F. D.
Templeton, No. 122,	G. R. Johnson, Templeton.	Mrs. Lucy Hursey, Templeton.	Mrs. R. S. Titterton, Templeton.
Oxford, No. 123,	Robert B. Taft, Oxford.	Mrs. Horace L. Lamson, Oxford.	L. H. Cudworth, Oxford.
Ashland, No. 124,	Henry C. Burnham, Ashland.	Miss Fannie A. Pratt, Ashland, R. F. D.	Mrs. C. E. Burr, Ashland.
Upton, No. 125,	Wm. H. Wellington, Upton.	Mrs. Edith M. Pease, Upton.	Mrs. L. Jennie Chapman, West Upton.
Hubbardston, No. 126,	J. Frank Flagg, Hubbardston.	Harry E. Murdock, East Hubbardston.	Mrs. F. Mabel Stone, Hubbardston.
Amesbury, No. 127,	A. Willis Bartlett, Salisbury, R. F. D.	Mrs. Abbie M. Babb, Amesbury.	C. F. Tibbetts, Amesbury.
North Andover, No. 128,	Benj. W. Farnum, North Andover.	Jessie Barker, North Andover.	Walter H. Hayes, North Andover.
Gardner, No. 130,	Wm. D. Seaver, Gardner.	Arthur F. Johnson, Gardner.	Miss Mabel B. Cornwell, Gardner.
Boxborough, No. 131,	Ralph E. Whitcomb, West Acton, R.F.D.	Mrs. Louise Woodward, West Acton, R. F. D.	Alfred W. Cobleigh, West Acton, R. F. D.
North Brookfield, No. 132,	Chas. W. Witt, North Brookfield.	Mrs. Frances A. Cummings, North Brookfield.	Miss Clara A. Anderson, North Brookfield.

Berlin, No. 134,	Arthur E. Clark, Berlin.	Mrs. Adelaide R. C. Carpenter, Berlin.	I. Edmund Coulson, South Berlin.
Norfolk, No. 135,	William A. Day, Norfolk.	Silas E. Fales, Norfolk.	Mrs. Emma F. Holbrook, Norfolk.
East Blackstone, No. 137,	O. Fermor Fuller, Blackstone.	Mrs. Lucy A. Welch, Blackstone, R. F. D.	Mrs. Mae V. Sargent, Blackstone.
Northampton, No. 138,	A. J. Morse, Northampton.	Egbert I. Clapp, Northampton.	Oliver B. Bradley, Northampton.
East Sandwich, No. 139,	Lebina Jenkins, West Barnstable.	John Bursley, West Barnstable.	Mrs. Elizabeth H. Ware, Spring Hill.
West Boxford, No. 140,	Thomas Downs, Georgetown.	Chas. F. Austin, West Boxford.	Miss Matilda B. Lund, West Boxford.
Montague, No. 141,	Chas. M. Hemenway, North Leverett.	Rev. E. C. Hayes, Montague.	Miss Nellie E. Rist, Montague.
Bolton, No. 142,	Miss C. J. Daniels, Bolton.	Mrs. Geo. L. Taylor, Hudson.	Mrs. Geo. L. Whitcomb, Hudson.
Mendon, No. 143,	Frank H. Wood, Mendon.	James J. Nutter, Mendon.	Freeman C. Lowell, Mendon.
Franklin, No. 144,	Alice A. Duprez, Franklin.	Annie G. Saylor, Franklin.	L. W. Daniels, Franklin.
West Newbury, No. 146,	John K. Sargent, Merrimac.	Mrs. Elizabeth M. Newell, West Newbury.	Mrs. Agnes C. Smith, West Newbury.
West Springfield, No. 147,	Glenn C. Sevey, Springfield.	J. Frank Hayes, Chicopee.	Miss Edith A. Sykes, West Springfield.
Concord, No. 150,	Orlando E. Hatch, Concord.	Mrs. Julia Hosmer, Concord.	Mrs. S. Addie Garfield, Concord.
Agawam, No. 151,	W. H. Porter, Agawam.	Miss Frances M. Ely, Agawam.	Mrs. Carrie L. Hayward, Agawam.
East Longmeadow, No. 152,	H. I. Moody, East Longmeadow.	M. H. Pease, East Longmeadow.	Mrs. C. B. Endicott, East Longmeadow.
Wilbraham, No. 153,	George W. Hulme, Wilbraham.	Miss Ruth A. Mossman, Wilbraham, R. F. D.	Mrs. Luthera E. Bosworth, Ludlow, R. F. D.
Haverhill, No. 154,	Fred E. Hall, Ayer's Village.	Miss Lizzie Webster, Ayer's Village.	Mrs. Grace A. Merrill, Haverhill.
Methuen, No. 155,	Frank A. Gordon, Methuen.	Mrs. Silvia C. Hill, Methuen.	Mrs. Blanche A. Blodgett, Methuen.
West Bridgewater, No. 156,	Howard B. Wilbur, West Bridgewater.	Theodore H. Eaton, Cochesset.	Rhoda F. Wilbur, West Bridgewater.
Granby, No. 157,	W. F. Forward, Granby.	P. E. Davis, Granby.	Mrs. P. E. Davis, Granby.
"Nemasket" of Middleborough, No. 158.	J. Herbert Cushing, Middleborough.	Mrs. Myrtis Higgins, Middleborough.	Mrs. Annie D. Deane, Middleborough.
South Hadley, No. 160,	Chester L. Johnson, South Hadley.	Mrs. H. W. Gaylord, South Hadley Falls.	I. N. Day, South Hadley.
"Laurel" of West Newbury, No. 161.	Chas. F. Brown, West Newbury, R. F. D.	Edith M. Forsyth, West Newbury, R.F.D.	Elmer D. Coskery, West Newbury.
Dartmouth, No. 162,	Charles E. Soule, Dartmouth.	Alice Davoll, Dartmouth.	Marcus M. Allen, Dartmouth.
Dudley, No. 163,	Dyer S. Elliot, Dudley.	Miss Alice M. Arnold, Dudley.	Miss R. D. Vinton, Dudley.
Ware, No. 164,	Frank W. Harwood, Ware.	Mrs. Mary L. Pierce, Ware.	Miss Emma Spellman, Ware.
Wellesley, No. 166,	Richmond Favour, Natick.	John M. Mills, Needham.	Mrs. Milton A. Parker, Wellesley.
Rowe, No. 167,	Wayne D. Wood, Zoar.	A. P. Goldthwait, Rowe.	Miss Ella Fisk, Rowe.
Somerset, No. 168,	Geo. W. Rice, Pottersville.	Geo. B. Marble, Somerset, R. F. D.	Miss Lois A. Davis, Somerset, R. F. D.
Lunenburg, No. 169,	J. Phillip Gilchrest, Lunenburg.	Miss May V. Estabrook, Lunenburg.	James Hildreth, Lunenburg.

MASSACHUSETTS PATRONS OF HUSBANDRY — *Continued.*

NAME.	MASTER.	LECTURER.	SECRETARY.
New Braintree, No. 170,	L. B. Sanford, New Braintree.	S. L. Dickinson, New Braintree.	Mrs. Ida M. Havens, New Braintree.
Merrimac, No. 171,	George B. Cofut, Merrimac.	Mrs. Frank E. Bartlett, Merrimac.	Mrs. Edson C. Walker, Merrimac.
Ashby, No. 172,	Wm. S. Green, Ashby.	Chas. H. Loomis, Ashby.	Mrs. Evelyn H. Lawrence, Ashby.
Hopkinton, No. 173,	George Mortimer, Hopkinton.	Mrs. Abbie Gowell, Hopkinton.	Miss Clara Rollins, Woodville.
Brookfield, No. 174,	Robert H. Hyde, West Brookfield.	Dr. Mary H. Sherman, Brookfield.	Mrs. Lottie F. Clark, Brookfield.
Athol, No. 175,	B. Madison Rice, Athol.	Anna C. Bacon, Athol.	Sarah L. Smith, Athol.
"Miller's River" of Orange, No. 176.	L. G. Bassett, Orange.	Mrs. Ida M. Bassett, Orange.	Harvey H. Baker, Orange.
Sturbridge, No. 177,	Mrs. Mary Q. Ainesworth, East Brookfield.	Mrs. Henry J. Ladd, Sturbridge.	Harry C. Shepherd, Globe Village.
Ludlow, No. 179,	Caleb B. Estey, Ludlow Centre.	Mrs. Bertha Taylor, Granby.	Mrs. Lizzie C. Chapman, Ludlow.
West Brookfield, No. 180,	Mrs. Nellie J. L. Canterbury, West Brookfield.	Mrs. Clara L. Haskins, West Brookfield.	Mrs. Carrie E. Webb, West Brookfield.
Westport, No. 181,	C. R. Macomber, Westport.	Samuel T. Brightman, Central Village.	Arthur T. Potter, Westport.
Southbridge, No. 182,	Ernest E. Corbin, Southbridge.	Mrs. Jennie E. Vinton, Southbridge.	Miss Adella Hare, Southbridge.
Andover, No. 183,	Frank M. Foster, Andover.	Edw. W. Boutwell, Lowell, R. F. D.	Edw. W. Burtt, Andover, R. F. D.
Topsfield, No. 184,	William A. Fuller, Topsfield.	Benj. Balch, Topsfield.	M. E. Jackman, Topsfield.
Milton, No. 185,	D. Henry Hunt, North Attleborough, R. F. D.	Miss Fannie E. Everett, Abbott Run, R.I.	Miss Ruth E. Hunt, North Attleborough.
Fitchburg, No. 186,	Herbert L. Hill, Fitchburg.	Mrs. Annie G. Cutting, Fitchburg.	Mrs. Herbert L. Hill, Fitchburg.
Littleton, No. 188,	C. V. Flagg, Concord Junction, R. F. D.	Mrs. L. M. Stephens, Littleton Common.	Mrs. Jennie F. Robbins, Littleton.
Warren, No. 189,	Calvin Bliss, Warren.	John W. Williams, Warren.	Mrs. Alice M. Bliss, Warren.
Bellingham, No. 190,	Mrs. Annie I. White, Bellingham.	Mrs. Annie C. Whiting, Bellingham.	Ada H. Greenwood, Milford.
Winchendon, No. 192,	Clifford H. Foster, Winchendon.	Mrs. Luella E. Wright, Winchendon.	Charles W. Brooks, Winchendon.
Foxborough, No. 193,	Samuel J. Johnston, Foxborough.	Mrs. Aurelia L. Dupee, Foxborough.	Adella O. Drake, Foxborough.
Townsend, No. 194,	Mrs. Clara C. Flarity, Townsend.	Miss Edna L. Wilder, Townsend.	George A. Wilder, Townsend.
Royalston, No. 195,	C. A. Stimson, Athol, R. F. D.	Mrs. Edith Small, Royalston.	Mrs. Ellen M. Stockwell, Royalston.
Easton, No. 196,	Wm. N. Howard, South Easton.	Mrs. Lynda P. Howard, South Easton.	Mrs. Emily M. Drew, North Easton.

"Brookville" of Holbrook, No. 197.	E. E. Bowen, Brookville.	Mrs. James A. Stowers, Holbrook.	Miss Ada M. Soule, Brookville.
Leominster, No. 198,	W. J. Nutting, Leominster.	F. N. Boutelle, North Leominster.	C. F. Walker, North Leominster.
Stoughton, No. 199,	Mrs. Edna F. Tilden, Stoughton.	Ernest H. Gilbert, North Easton, R.F.D.	Mrs. Jennie M. Spaulding, Stoughton.
Uxbridge, No. 200,	Samuel F. Thayer, Uxbridge.	Mrs. Kate M. Thom, Uxbridge.	Mrs. Josephine Davis, Millville.
Bridgewater, No. 201,	E. Lincoln Copeland, Bridgewater, R. F. D.	Miss Edith A. Freeman, Bridgewater.	Lucius C. Wood, Bridgewater.
Ashburnham, No. 202,	Orrie A. Lane, Ashburnham.	Mrs. Imogene S. Hunt, Ashburnham.	Mrs. Sadie M. Fosgate, Ashburnham.
Westminster, No. 203,	Fred G. Parcher, Westminster.	Miss Emma J. Goddard, Westminster.	Miss Sadie Rice, Westminster.
Rowley, No. 204,	Mrs. Louise C. Bradstreet, Rowley.	Mrs. Alice A. Marshall, Rowley.	J. A. Marshall, Rowley.
"Webster" of Marshfield, No. 205,	Leroy C. Bartlett, Marshfield Center.	Alpheus H. Walker, Millbrook.	Miss Anna N. Belknap, Marshfield.
Tewksbury, No. 207,	Geo. E. Crosby, Lowell, R. F. D.	Miss M. Nellie French, Lowell.	Miss S. C. Whittemore, Tewksbury Centre.
Westford, No. 208,	Frank C. Wright, Westford, R. F. D.	Rev. Charles P. Marshall, Westford.	Mrs. Frank C. Wright, Westford.
Chicopee, No. 211,	E. L. Shaw, Chicopee.	W. E. Chapin, Chicopee.	Mrs. Cassie E. DeGowin, Chicopee.
"Oak Hill" of Attleborough, No. 212.	Samuel W. Cash, Attleborough, R. F. D.	Miss E. L. West, Attleborough, R. F. D.	Mrs. M. P. Smith, Attleborough, R. F. D.
Walpole, No. 214,	Harry A. Whiting, South Walpole.	Nathan W. Fisher, Walpole, R. F. D.	Mrs. Annie E. Gay, Walpole.
Mattapoisett, No. 215,	Dr. Erving N. Tilden, Mattapoisett.	Mrs. Lucy A. Barlow, Mattapoisett.	Mrs. Alice W. Ashley, Mattapoisett.
Dracut, No. 216,	Elliott Morgan, Lowell, R. F. D.	Mrs. Mabel L. Colburn, Dracut.	Miss Rose E. Peabody, Lowell, R. F. D
Mansfield, No. 217,	Howard Fisher, Mansfield.	John Collins, Mansfield.	A. H. Bolton, Mansfield, R. F. D.
Norton, No. 218,	Allison J. Cowles, Norton.	Miss Susan M. Barker, Norton.	Miss Laura F. Barker, Norton.
East Princeton, No. 219,	Wm. H. French, East Princeton.	Mrs. Alwilda Drury, East Princeton.	A. O. Tyler, East Princeton.
Sunderland, No. 220,	George E. Clark, Sunderland.	Milton H. Williams, Sunderland.	Mrs. Mattie A. Ward, South Deerfield.
"Anawan" of Rehoboth, No. 221,	Elmer J. Wade, Taunton.	Miss Edith Tracy, Rehoboth Village.	Miss Lillian Eddy, Rehoboth, R. F. D.
Tyngsborough, No. 222,	Chas. P. Littlehale, Tyngsborough.	Wm. J. Collins, North Chelmsford.	Mrs. Annie E. Wood, Lowell, R. F. D.
Billerica, No. 223,	Frank H. Alexander, Wilmington.	Walter E. Morris, Billerica.	Cora Baker, Billerica.
Sheffield, No. 224,	Fred F. Hulett, Sheffield.	Z. H. Cande, Sheffield.	A. I. Hoyt, Sheffield.
Williamsburg, No. 225,	Luther H. Warner, Florence.	Mrs. R. D. Ames, Williamsburg.	John W. Hartwell, Williamsburg.
West Medway, No. 226,	Wm. B. Ballard, West Medway.	Mrs. H. Louise Gurney, West Medway.	Mrs. Luella F. Moon, West Medway.
Heath, No. 227,	Justus W. Stetson, North Heath.	Mrs. Ethel Stetson, Heath.	Mrs. Mabel Payne, Heath.
Salisbury, No. 228,	Roy L. Eaton, Salisbury.	Miss Annie Clancy, Salisbury.	Miss Annie M. Pike, Salisbury.
Cochituate, No. 229,	John J. Erwin, Wayland.	Miss Grace C. Loker, Cochituate.	Mrs. Gertrude D. Bishop, Cochituate.

MASSACHUSETTS PATRONS OF HUSBANDRY — *Concluded.*

NAME.	MASTER.	LECTURER.	SECRETARY.
Taunton, No. 230,	Edwin L. Lewis, Taunton.	Wm. S. Lamson, Bridgewater.	Clifford A. Field, Taunton.
"Ponkapoag" of Canton, No. 231,	Joseph W. Farwell, Ponkapoag.	Miss Isabella C. McIntyre, Milton.	Mrs. Nettie F. Farwell, Ponkapoag.
Plainfield, No. 232,	Arthur R. Tirrell, Plainfield.	Mrs. Arthur R. Tirrell, Plainfield.	Miss Anna M. King, Plainfield.
Lexington, No. 233,	George S. Teague, Lexington.	Arthur E. Horton, Lexington.	Miss Bertha E. Whitaker, Lexington.
Newbury, No. 234,	George H. Ilsley, Newbury.	Miss Mary A. Rolfe, Newburyport.	Miss Marcia E. Little, Newbury.
Oakham, No. 235,	John P. Day, Oakham.	Miss Sara E. Butler, Oakham.	Mrs. John P. Day, Oakham.
"Quascacunquen" of Byfield, No. 236.	Asa Pingree, Rowley, R. F. D.	Mrs. Josephine Senior, Rowley, R.F.D.	Miss Bertha F. Taylor, Rowley, R. F. D.
Groveland, No. 237,	Andrew S. Longfellow, Groveland.	Miss Mabelle M. Brown, Groveland.	Miss Bessie P. Brown, Groveland.
Bradford, No. 238,	Edward M. Nason, Bradford.	Miss Mabel D. Barnes, Haverhill.	Miss Sarah B. Barnes, Haverhill.
North Reading, No. 239,	Amos W. Doten, North Reading.	Miss Elizabeth L. Hayward, South Middleton.	Miss Annie B. Hogan, North Reading.
Shelburne Falls, No. 240,	Geo. W. McKnight, Shelburne Falls.	Mrs. George McKnight, Shelburne Falls.	Mrs. Cheney Hunter, Shelburne Falls.
Palmer, No. 241,	C. C. Keep, Monson.	Mrs. Sarah L. Whiting, Thorndike.	Miss Helen L. Stimson, Palmer.
Rutland, No. 242,	Geo. H. Miles, Rutland.	Louis M. Hauff, Rutland.	Alice M. Wales, Rutland.
Enfield, No. 243,	Chas. W. Felton, Enfield.	Harry L. Ryther, Enfield.	Fred K. Davis, Enfield.
Chelmsford, No. 244,	W. B. Lapham, South Chelmsford.	Mrs. F. J. Spaulding, Lowell.	Mrs. E. T. Adams, Chelmsford.
Greenwich, No. 245,	S. R. Thrasher, Ware.	Mrs. Jennie Lincoln, Greenwich Village.	Mrs. Lilla M. Bishop, Greenwich.
West Stockbridge and Alford, No. 246.	Thomas L. Curren, Housatonic, R. F. D.	Jess F. Bliss, State Line.	Fabian V. Petit, Housatonic, R. F. D.
"Harmony" of Easton, No. 247,	Ossiane D. Ripley, Easton.	Miss Carrie Keith, Easton.	Frank L. Wills, Easton.
Wendell, No. 248,	N. B. Symonds, Wendell.	Mary E. White, Wendell.	Mrs. N. B. Symonds, Wendell.
Baldwinsville, No. 249,	Geo. H. Lawrence, Baldwinsville.	Mrs. Frances Viall, Baldwinsville.	Miss Alta Lund, Baldwinsville.
Everett, No. 250,	Joseph H. Jackman, Everett.	Mrs. A. L. F. Jackson, Everett.	C. E. Dinslow, Everett.
West Tisbury, No. 251,	Cortland D. Fairchild, West Tisbury.	Mrs. Evelyn M. Adams, West Tisbury.	Mrs. Celia A. Smith, West Tisbury.
"Wachusett" of Leominster, No. 252.	E. C. Hatstat, Leominster.	Mrs. J. H. Johnson, Leominster.	Mrs. Flora C. Bruce, Leominster.
Halifax, No. 253,	Fred Simpson, Whitman, R. F. D.	Mrs. J. B. Baker, Halifax.	Edwin G. Doe, Whitman, R. F. D.

INDEX.

PUBLIC DOCUMENT . . . . No. 33.

EIGHTEENTH ANNUAL REPORT

OF THE

HATCH EXPERIMENT STATION

OF THE

MASSACHUSETTS AGRICULTURAL COLLEGE.

JANUARY, 1906.

BOSTON:
WRIGHT & POTTER PRINTING CO., STATE PRINTERS,
18 POST OFFICE SQUARE.
1906.

Approved by

The State Board of Publication.

HATCH EXPERIMENT STATION

OF THE

MASSACHUSETTS AGRICULTURAL COLLEGE,

AMHERST, MASS.

ORGANIZATION.

Committee on Experiment Department.

JAMES DRAPER, *Chairman.*
J. LEWIS ELLSWORTH.
WILLIAM H. BOWKER.
CHARLES H. PRESTON.
SAMUEL C. DAMON.
THE PRESIDENT OF THE COLLEGE, *ex officio.*

Station Staff.

CHARLES A. GOESSMANN, PH.D., LL.D.,	*Honorary Director and Chemist* (fertilizers).
WILLIAM P. BROOKS, PH D.,	*Director and Agriculturist.*
GEORGE E. STONE, PH.D.,	*Botanist.*
JOSEPH B. LINDSEY, PH.D.,	*Chemist* (foods and feeding).
CHARLES H. FERNALD, PH.D.,	*Entomologist.*
FRANK A. WAUGH, M.S.,	*Horticulturist.*
J. E. OSTRANDER, C E.,	*Meteorologist.*
HENRY T. FERNALD, PH.D.,	*Associate Entomologist.*
FREDERICK R. CHURCH, B.SC.,	*Assistant Agriculturist.*
NEIL F. MONAHAN, B.SC.,	*Assistant Botanist.*
HENRI D. HASKINS, B.SC.,	*First Assistant Chemist* (fertilizers).
EDWARD G. PROULX, B.SC.,	*Second Assistant Chemist* (fertilizers).
E. THORNDIKE LADD, D.SC.,	*Third Assistant Chemist* (fertilizers).
EDWARD B. HOLLAND, M.S.,	*First Chemist* (foods and feeding).
PHILIP H. SMITH, B.SC.,	*Assistant Chemist* (foods and feeding).
ARTHUR C. WHITTIER, B.SC.,	*Assistant Chemist* (foods and feeding).
FRANK G. HELYAR, B.SC.,	*Inspector* (foods and feeding).
SUMNER R. PARKER, B.SC.,	*Dairy Tester* (foods and feeding).
ROY F. GASKILL,	*Assistant in Foods and Feeding.*
WALTER B. HATCH, B.SC.,	*Assistant Horticulturist.*
CLIFTON H. CHADWICK,	*Observer.*

REPORT OF THE DIRECTOR.

WILLIAM P. BROOKS, DIRECTOR.

The work of the Hatch Experiment Station during the past year has progressed under favorable conditions. The only changes in the station staff have been a few affecting minor positions, which are elsewhere referred to. There has accordingly been no interruption in the lines of investigation which have been in progress.

Besides the monthly meteorological bulletins, during the past year four other bulletins have been issued: Nos. 103 and 104 on the subject of fertilizers and the results of analyses thereof; No. 105 on tomatoes under glass and methods of pruning tomatoes; and No. 106 on condimental stock and poultry foods.

The work of the section of our division of chemistry having to do with fertilizers shows that the conditions of the fertilizer trade in the State are substantially the same as during recent years. The manufacturers and dealers still offer an enormous number of different brands of so-called complete and special fertilizers in the markets. The number of samples analyzed during the past year is 511, representing 313 distinct brands. There can be no doubt that the business of manufacturing and selling fertilizers might easily be greatly simplified; that a great reduction in the number of brands offered, without loss in any direction, is possible; and that the result of such simplification and reduction in the number of brands would be that fertilizers sufficiently varied for every purpose could be furnished to the farmers at lower prices than those at present prevailing.

The fertilizer section of our division of chemistry has during the past year analyzed the usual number of samples

of miscellaneous materials, wood ashes, lime ashes, soils, etc. Such samples as are sent in by the farmers are usually analyzed and the results reported without charge.

The bulletin on tomatoes under glass is an important contribution to knowledge on the best methods of handling this crop, which is coming to be one of much importance in this State. Bulletin No. 106, on condimental stock and poultry foods, presents analyses of a large number of foods coming under these classes. It discusses the utility of such foods, and their cost as compared with the more common food stuffs. It is clearly shown that their cost is in excess of what appears to be a perfectly fair estimate of their value. The bulletin presents a brief résumé of the results of experiments in the use of stock and poultry foods, which tends to show that the claims made for these foods are not justified by facts. The results of an experiment in the department of foods and feeding are presented and discussed, the conclusion being that the food under trial (Pratt's) did not appear to be superior in any way to a like mixture of corn meal and wheat middlings, while the cost was considerably greater.

In the division of foods and feeding, under Dr. J. B. Lindsey, a number of other important lines of investigation have been followed during the year. A somewhat full statement of the results in a number of these will be found in Dr. Lindsey's report, which is transmitted herewith. Among the more important results of these investigations are the following points: Bibby's dairy cake, a food which has been persistently urged upon the attention of our milk producers, has been carefully tested, but has been found to be less satisfactory from an economical point of view than some of the ordinary food stuffs.

Eureka corn has been carefully compared with Sibley's Pride of the North corn, from the standpoint both of production and of food value. It is found that, although the Eureka gives a much heavier yield, the excess in weight is made up almost exclusively of water. The food value of the product of an acre of Eureka corn is not equal to the food value of the much smaller acre product of Sibley's Pride of the North.

Wheat bran has been compared with corn silage, in connection in both cases with some of the more nitrogenous concentrates, as food for milch cows. The results indicate that silage is equally as satisfactory as the bran, and that by substitution of silage for the bran the necessary outlay for purchased foods in milk production can be greatly reduced.

This division has carried out an interesting investigation into the conditions prevailing in milk production in Amherst and neighboring towns. It is found that the conditions are often quite unsanitary; that bacteria are frequently exceedingly numerous in the milk, indicating improper methods of handling; and that in general there is urgent need of improvement. In the judgment of Dr. Lindsey, the results of this investigation indicate the desirability of the establishment of some regular system of inspecting dairies. It is believed that this is something which consumers in increasing numbers will be likely to insist upon in the near future.

In the horticultural division the only investigation sufficiently advanced to justify report is that undertaken, and in part reported upon in our last annual report, on methods of pruning peach trees injured by winter-killing. It will be remembered that four systems were under trial: no pruning, light pruning, moderate pruning, and severe pruning. Severe pruning consisted in removing nearly all the branches of the injured tree. The observations of another year lead to the conclusion that this system cannot be recommended. A more moderate pruning, consisting of the removal of from one-third to one-half of the growth of the previous year, seems to have given results which are on the whole most satisfactory; and such pruning is recommended in all cases when the wood has been injured by winter-killing. If only the fruit buds have been destroyed by the winter, it is recommended to prune back the previous season's growth severely, leaving only two or three buds.

In the entomological division, experiments are in progress with a view to determining the definite strength of hydrocyanic acid gas which can be used with safety on plants in greenhouses under varying conditions of growth.

In the report of the division of botany and vegetable pathology will be found a discussion of the general conditions as affecting plant diseases during the past year; references to the somewhat unusual attack of the potato rot fungus (*Phytopthora infestans*) on the tomato; and a discussion of the causes of sun scald and the browning of the foliage of conifers and other evergreens.

The report of the vegetable pathologist, Dr. George E. Stone, includes also a suggestive discussion on winter-killing as affecting trees and shrubs, as a result of the exceptionally cold winters 1902–03 and 1903–04.

The great importance of suitable aeration of the soil for perfect germination of certain seeds is brought out by another paper. The effects of sterilization of soils respectively rich and low in organic matter on germination and the growth of plants have been investigated. It has been found that, if the soil is rich in organic matter, sterilization is favorable both to germination and subsequent growth; but if the soil contains little organic matter, such treatment is unfavorable.

The influence of treating seeds in soil decoctions of varying strengths has been carefully studied, and it is shown that such decoctions from sterilized soil when highly diluted exercise a favorable effect on germination. The report of Dr. Stone includes also the presentation and discussion of results of various methods of seed selection. The conclusion is that, for seeds adapted to that method of handling, the use of sieves of suitable mesh as a means of separating the small and inferior seeds is strongly to be recommended. The use of other methods of separation in the case of seeds which cannot be successfully handled by sifting is urged, as being of much importance.

The work of the agricultural division during the past year has followed the usual lines, and is elsewhere briefly summarized.

Among the different bulletins and reports which have been issued by the station, the following are still in stock and can be furnished on demand: —

No. 3. Tuberculosis.
No. 27. Tuberculosis in college herd; tuberculin in diagnosis; bovine rabies; poisoning by nitrate of soda.
No. 33. Glossary of fodder terms.
No. 41. On the use of tuberculin (translated from Dr. Bang).
No. 64. Analyses of concentrated feed stuffs.
No. 67. Grass thrips; treatment for thrips in greenhouses.
No. 75. Fertilizer analyses.
No. 76. The imported elm-leaf beetle.
No. 77. Fertilizer analyses.
No. 81. Fertilizer analyses; treatment of barnyard manure with absorbents; trade values of fertilizing ingredients.
No. 82. Orchard management; cover crops in orchards; pruning of orchards; report on fruits.
No. 83. Fertilizer analyses.
No. 84. Fertilizer analyses.
No. 87. Cucumbers under glass.
No. 89. Fertilizer analyses; ash analyses of plants; instructions regarding sampling of materials to be forwarded for analysis.
No. 90. Fertilizer analyses.
No. 92. Fertilizer analyses.
No. 95. Fertilizer analyses; notes on barnyard manure; trade values of fertilizing ingredients.
No. 96. Fungicides; insecticides; spraying calendar.
No. 97. A farm wood lot.
No. 98. Inspection of concentrates.
No. 99. Dried molasses beet pulp; the nutrition of horses.
No. 100. Fertilizer analyses; market values of fertilizing ingredients.
No. 102. Analyses of manurial substances and fertilizers; market values of fertilizing ingredients.
No. 103. Analyses of manurial substances; instructions regarding sampling of materials to be forwarded for analysis; instructions to manufactures, importers, agents and sellers of commercial fertilizers; discussion of trade values of fertilizing ingredients.
No. 104. Analyses of manurial substances and licensed fertilizers; market values of fertilizing ingredients.
No. 105. Tomatoes under glass; methods of pruning tomatoes.

No. 109. Condimental stock and poultry foods.
Special bulletin, — The coccid genera Chionaspis and Hemichionaspis.
Technical bulletin, No. 1, — Greenhouse Aleyrodes; strawberry Aleyrodes.
Technical bulletin, No. 2, — The graft union.
Index, 1888–95.
Annual reports, 1898, 1899, 1900, 1901, 1902, 1903, 1904, 1905, 1906.

Of most of the other bulletins a few copies remain, which can be supplied only to complete sets for libraries.

The co-operation and assistance of farmers, fruit growers and horticulturists, and all interested directly or indirectly in agriculture, are earnestly requested. Communications may be addressed to the "Hatch Experiment Station, Amherst, Mass."

ANNUAL REPORT

Of George F. Mills, *Treasurer* of the Hatch Experiment Station of Massachusetts Agricultural College,

For the Year ending June 30, 1905.

Cash received from United States Treasurer,		$15,000 00
Cash paid for salaries,	$6,992 42	
for labor,	1,788 14	
for publications,	782 84	
for postage and stationery,	367 35	
for freight and express,	221 78	
for heat, light, water and power,	544 60	
for chemical supplies,	106 39	
for seeds, plants and sundry supplies,	410 48	
for fertilizers,	738 11	
for feeding stuffs,	379 78	
for library,	78 36	
for tools, implements and machinery,	398 37	
for furniture and fixtures,	162 26	
for scientific apparatus,	586 31	
for live stock,	127 05	
for travelling expenses,	158 46	
for contingent expenses,	25 00	
for building and repairs,	1,132 30	
		$15,000 00

Cash received from State Treasurer,	$13,625 00	
from fertilizer fees,	4,365 00	
from farm products,	1,512 95	
from miscellaneous sources,	3,463 70	
Balance June 30, 1904,	3,383 55	
		$26,350 20

Cash paid for salaries,	$13,678 34	
for labor,	2,337 59	
for publications,	651 50	
for postage and stationery,	308 52	
for freight and express,	136 62	
for heat, light, water and power,	1,021 32	
for chemical supplies,	615 56	
for seeds, plants and sundry supplies,	451 51	
for fertilizers,	7 39	
for feeding stuffs,	613 28	
for library,	92 08	
for tools, implements and machinery	17 33	
for furniture and fixtures,	174 11	
for scientific apparatus,	735 74	
for live stock,	172 00	
for travelling expenses,	1,400 79	
for buildings and repairs,	198 86	
Balance,	3,737 66	
		$26,350 20

I, Charles A. Gleason, duly appointed auditor of the corporation, do hereby certify that I have examined the accounts of the Hatch Experiment Station of the Massachusetts Agricultural College for the fiscal year ended June 30, 1905; that I have found the same well kept and classified as above; that the receipts for the year from the Treasurer of the United States are shown to have been $15,000, and the corresponding disbursements $15,000; for all of which proper vouchers are on file and have been by me examined and found correct, thus leaving no balance of the $15,000; and that $3,737.66 are left of the State appropriation and of funds received from miscellaneous sources.

CHARLES A. GLEASON,
Auditor.

AMHERST, Aug. 7, 1905.

REPORT OF THE METEOROLOGIST.

J. E. OSTRANDER.

The attention of this division during the year has been largely confined to the work of making the usual observations of the various weather phenomena and a proper tabulation of these records, together with such computations as are found necessary for the purpose of comparison. The installation of some new apparatus has required some changes in the manner of tabulation, but the only effect on the results is to render them more accurate.

At the beginning of each month the usual bulletin of four pages has been issued, giving the more important daily records and monthly means, together with a summary of the results. The annual summary will be issued as a part of the December bulletin. In addition to issuing the bulletins, a considerable number of letters have been required to answer specific inquiries regarding rainfall, temperature and other features of the weather.

This station, being one of the voluntary observers' stations of the United States Weather Bureau, has furnished the section director at Boston with the usual monthly reports, and has also agreed to furnish the weekly snow reports during the winter. A phenological record has also been made, and a copy furnished the section director at his request.

The local forecast official at Boston has furnished this station with the local weather predictions daily except Sundays, and the proper signals have been displayed from the flagstaff on the tower. It was found necessary to shorten the flagstaff a few feet, but this has not resulted in making the signals less noticeable.

Owing to the unsatisfactory records made by some of the Draper self-recording instruments in the tower, it was decided to secure some of other make whose records would be more precise. Accordingly, a triple electric register for recording sunshine, rainfall and wind velocity was purchased from Julien P. Friez, and during the summer vacation the wiring was done to put it in working order. The sunshine recorder was mounted on top of the tower and connected by wires to the register in the tower. Two Edison primary batteries furnish the current required to operate the register at intervals of one minute while the sun is shining. A tipping-bucket rain gauge on the campus is connected to the register in the tower by more than a thousand feet of wire, and each one-hundredth of an inch of rainfall is registered. This furnishes a record of the rate of precipitation during a storm, as well as the total amount. The record is also checked by measurement in a standard rain gauge. A small anemometer of the Weather Bureau pattern was mounted on top of the tower in place of the Draper rain gauge, which was taken down, and each mile of wind travelled is recorded on the register below. As the drum on which all the above-mentioned records are made travels at a rate of nearly three miles per hour, the records are very distinct, and variations in rate of wind movement, as well as in the rainfall, are easily noted. A set of maximum and minimum thermometers of the Weather Bureau pattern was purchased during the year, to replace others that were greatly worn.

The assistant observer, Mr. C. H. Chadwick, was advanced to the position of observer in June, succeeding Mr. G. W. Patch.

REPORT OF THE AGRICULTURISTS.

WM. P. BROOKS; ASSISTANTS, F. R. CHURCH, S. B. HASKELL.

The work of the agricultural department for the past year has closely followed the lines of recent years. The leading object of our work is, by long-continued comparative experiments, to throw light upon some of the many problems connected with the use of manures and fertilizers. The results of a single year may be of value as a guide to practice, but it is important to know concerning any given system, not alone the immediate effect upon the crop, but the ultimate effect upon the soil as well. This is made manifest only by continued manuring along definite lines. Thus, by long-continued comparison of different materials which may be used respectively as sources of any given plant food element, we may hope to determine their real and average relative value, and, by suitable rotation of crops, their relative suitability also for different plants. By continued experiment along definite lines in successive years we may hope, moreover, to discover the relation of season to the fertilizer efficiency of the different fertilizer materials under comparison. With definite knowledge concerning immediate effect upon the crop, ultimate effect upon the soil and differences in effect due to variations in seasons, we shall be in a position to give advice of value both to the farmer seeking to produce crops at lowest cost and to the fertilizer manufacturer. The work carried on in the department during the past season has involved the care of 244 field plots in our various fertilizer and variety tests, 150 closed plots and 245 pots in vegetation experiments. The work in the closed plots and the vegetation experiments serve as valuable checks upon the accuracy of field work, and enable us to

extend the scope of our investigations. Besides the care for all this work, we have a grass garden including 48 species and 7 varieties, most of which occupy one square rod each. Our work with poultry has followed the general lines of investigation of earlier years, the principal subject under investigation being the relations of different foods and food combinations to egg production. A detailed report of results obtained will be at this time presented for but a small number of the experiments in progress.

The principal subjects of inquiry discussed, and the more important results, very briefly stated, are as follows: —

I. — To determine the relative value of barnyard manure, nitrate of soda, sulfate of ammonia and dried blood, as sources of nitrogen. The crop of this year was mixed oats and peas for hay; and, on the basis of yield, the nitrogen-furnishing materials rank in the following order: nitrate of soda, dried blood, sulfate of ammonia, and barnyard manure. On the basis of increase, as compared with no-nitrogen plots, taking into account all the crops grown since the experiment began, the materials rank as follows: nitrate of soda, 100 per cent.; dried blood, 68.72 per cent.; sulfate of ammonia, 60.78 per cent.; barnyard manure, 86.58 per cent.

II. — To determine the relative value of muriate as compared with high-grade sulfate of potash for field crops. The results of this year indicate the sulfate to be superior to the muriate for clover, for rhubarb, and for blackberries.

III. — To determine the relative value of different potash salts for field crops. The salts under comparison are high-grade sulfate, low-grade sulfate, kainite, muriate, nitrate, carbonate, and silicate. The crop of this year was soy beans. The different potash salts rank in the following order: carbonate, high-grade sulfate, silicate, nitrate, muriate, low-grade sulfate, and kainite. The crop where the latter salt was used was by far the poorest in the field, being much lower than the crop of the plots to which no potash has been applied for the past eight years.

IV. — To determine the relative value in crop production of a fertilizer mixture rich in potash, as compared with one

representing the average of special corn fertilizers purchasable in our markets. The crop of this year was hay, — mixed timothy, red-top and clovers. The crops were substantially equal; but, as the cost of fertilizers is lower where the fertilizer richer in potash is used, the advantage is with that combination of materials.

V. — To determine the relative value in corn and hay production of a moderate application of manure alone, as compared with a smaller application of manure used in combination with 160 pounds of high-grade sulfate of potash per acre. The crop of this year was hay, — mixed timothy, red-top and clovers. The larger average yield was produced on the combination of manure and potash; and, as this combination costs $6.40 less per acre than the larger quantity of manure alone, the advantage in favor of the combination is decisive.

VI. — To determine which is better economy, to spread manure as hauled from the stable during the winter, or to place in a large heap to be spread in spring. This experiment occupies five pairs of plots. The spring application gave the better yield in all cases, but the difference was not sufficiently large to cover the larger cost of the extra handling involved in the case of the manure spread in the spring. The winter of 1904–05, however, was exceptionally favorable to good results from application at that season, as there was little or no wash over the surface.

VII. — To determine the economic result of using in rotation on grass lands: the first year, barnyard manure, 8,000 pounds per acre; the second year, wood ashes, 1 ton per acre; and the third year, bone meal, 600, and muriate of potash, 200, pounds per acre. The average yield of hay during the past season, all three systems of manuring being represented, on a total area of about 9 acres, is at the rate of about 4,840 pounds of hay per acre. The average for the thirteen years during which the experiment has continued, 1893–1905, inclusive, is 6,479 pounds.

VIII. — To determine whether the application of nitrate of soda after the harvesting of the first crop will give a profitable increase in the rowen crop. The increases produced

in the four pairs of plots under comparison were relatively small except in one instance. Nitrate applied at the rate of 250 pounds per acre gave an apparent increase of nearly 1 ton of rowen, which is considerably more than sufficient to cover the cost of the nitrate.

IX. — To test the relative value for the production of garden crops of fertilizers supplying respectively nitrogen and potash, when used with manure. The nitrogen fertilizers compared are dried blood, nitrate of soda and sulfate of ammonia. The use of the nitrate is attended with the greatest profit. On the basis of total crops produced, the relative standing of the different nitrogen fertilizers is: for the early crops, nitrate of soda, 100 per cent.; dried blood, 95.67 per cent.; sulfate of ammonia, 63.08 per cent.; for the late crops, nitrate of soda, 100 per cent.; dried blood, 98.77 per cent.; sulfate of ammonia, 79.52 per cent.

The potash salts under comparison are high-grade sulfate and muriate. For the fifteen years the relative standing of these fertilizers is: for the early crops, sulfate of potash, 100 per cent.; muriate of potash, 94.66 per cent.; for the late crops, sulfate of potash, 97.9 per cent.; muriate of potash, 100 per cent.

X. — To determine whether alfalfa is a profitable crop in Massachusetts. A large number of experiments tried during the past eight or ten years indicates that it is quite doubtful whether alfalfa can be successfully grown under our climatic conditions.

XI. — Comparison of different feeds and feed combinations furnishing the essential nutrients in varying proportions for laying hens. The results indicate corn to have superior merit among the different grains for the production of eggs, considered from the standpoint both of total number and economy of production. Rice is somewhat superior in number of eggs produced to corn, but the cost is so great as to render its use inexpedient.

I. — Manures and Fertilizers furnishing Nitrogen compared. (Field A.)

To make clear the plan of the experiment, which is continuous, I quote from the seventeenth annual report: —

> The experiments in Field A have two principal objects in view: first, to compare the efficiency (as measured by crop production) of a few standard materials which may be used on the farm as sources of nitrogen; second, to determine to what extent the introduction of a legume will render the application of nitrogen to a succeeding crop of another family unnecessary. The field includes eleven plots of one-tenth acre each. A full description of the plan followed will be found in the twelfth annual report of the Hatch Experiment Station. The materials furnishing nitrogen under comparison are barnyard manure, nitrate of soda, sulfate of ammonia and dried blood. With few and unimportant exceptions, each plot has been manured in the same way since 1890. All the plots annually receive equal and liberal amounts of materials supplying phosphoric acid and potash. Three plots in the field have had no nitrogen applied to them since 1884; the materials under comparison on the other plots in the field are applied in such quantities as to furnish nitrogen at the rate of 45 pounds per acre to each. Barnyard manure is applied to one plot, nitrate of soda to two, sulfate of ammonia to three and dried blood to two plots. The potash applied to these plots is supplied in the form of muriate to six plots, namely, 1, 3, 6, 7, 8 and 9. It is supplied in the form of low-grade sulfate to four plots, namely, 2, 4, 5 and 10.

The crops grown in this experiment previous to this year in the order of their succession have been: oats, rye, soy beans, oats, soy beans, oats, soy beans, oats, oats, clover, potatoes, soy beans, potatoes, soy beans, potatoes.

The condition of the soil of this field during the last year or two had indicated quite clearly that it would be benefited by liming. Freshly water-slaked lime was used. It was applied by the use of Kemp's manure spreader, adjusted with a view to applying lime as closely as possible at the rate of 1 ton to the acre. The amount actually applied to

$1\frac{1}{10}$ acre was 2,395 pounds, so that the lime was used in slightly greater quantity than intended. The work of the spreader in applying lime is quite satisfactory. There is no difficulty in adjusting it to apply any desired amount with substantial accuracy. Any chance that the amounts applied to the different plots in such experiments as those in progress on Field A will differ is avoided by driving the spreader in applying the lime the full length of the field across the plots.

The crop of this year was oats and peas. The lime was applied on April 26, and plowed in, and Canada peas at the rate of $1\frac{1}{2}$ bushels per acre were sown on April 28, and deeply harrowed in. On April 29 the fertilizers were applied, and harrowed in. The oats were of the Clydesdale variety. They were sown at the rate of 1 bushel to the acre on May 1, and harrowed in. No accidental conditions likely to interfere with the experiment were noted, although the rank growth on the plots receiving nitrogen in the most highly available form (nitrate of soda and sulfate of ammonia) resulted in considerable lodging, which no doubt decreased the yield on those plots.

The rates of yield on the several plots and the source of nitrogen on each are shown in the following table: —

Yield of Oats and Peas per Acre.

Plots.	Nitrogen Fertilizers used.	Hay (Pounds).
0, . .	Barnyard manure, ...	4,950
1, . .	Nitrate of soda (muriate of potash), ...	6,900
2, . .	Nitrate of soda (sulfate of potash), ...	7,000
3, . .	Dried blood (muriate of potash), ...	6,700
4, . .	No nitrogen (sulfate of potash), ...	4,350
5, . .	Sulfate of ammonia (sulfate of potash), ...	5,650
6, . .	Sulfate of ammonia (muriate of potash), ...	6,600
7, . .	No nitrogen (muriate of potash), ...	4,800
8, . .	Sulfate of ammonia (muriate of potash), ...	6,900
9, . .	No nitrogen (muriate of potash), ...	3,900
10, . .	Dried blood (sulfate of potash), ...	6,500

It will be noticed that the yield on the three no-nitrogen plots (4,7,9) is much below the yield obtained on any of the plots where fertilizers supplying nitrogen were used. There was a fair proportion of peas in the crop, but, in spite of the fact that peas are usually able to take a considerable proportion of their nitrogen from the air, it is very clear that it will be unwise, in the case of a mixed crop including a legume and a non-legume, to depend to any great extent upon this atmospheric source of supply. The average yield of the three no-nitrogen plots was at the rate of 4,350 pounds of hay per acre. The average yield of the nitrogen plots was at the rate of 6,400 pounds per acre. Here is a difference of a little more than 1 ton per acre, which is far more than sufficient to cover the cost, $7.85, of the amounts in which such fertilizer was used. It will be noticed, further, that the yield on the plot to which barnyard manure is annually applied is much below that on even the poorest plot to which a nitrogen fertilizer was applied. The manure in question was put on at the time of preparing the soil in the spring, and evidently the nitrogen it contained did not become in large degree available in season to benefit crops making their growth so early in the growing season as oats and peas. The average yields of this year on the several fertilizers are shown in the following table: —

Fertilizers used.	Hay (Pounds).
Average of the no-nitrogen plots (4, 7, 9),	4,350
Average of the nitrate of soda plots (1, 2),	6,950
Average of the dried-blood plots (3, 10),	6,600
Average of the sulfate of ammonia plots (5, 6, 8),	6,383

As the result of experiments previous to this year, it has been found that the materials furnishing nitrogen have produced crops in the following relative amounts: —

	Per Cent.
Nitrate of soda,	100.00
Barnyard manure,	96.02
Dried blood,	90.83
Sulfate of ammonia,	88.62
No nitrogen,	72.11

Similar averages for this year are as follows: —

	Per Cent.
Nitrate of soda,	100.00
Dried blood,	94.96
Sulfate of ammonia,	91.84
Barnyard manure,	71.22
No nitrogen,	62.60

Combining the results showing relative standing in 1905 with similar figures for all the years previous to 1905, the relative standing is as follows: —

	Per Cent.
Nitrate of soda,	100.00
Barnyard manure,	94.47
Dried blood,	91.09
Sulfate of ammonia,	88.83
No nitrogen,	71.52

The figures showing relative standing of the different materials furnishing nitrogen as compared with the no-nitrogen plots so far given are based upon the total yield. If we compare the different materials used as sources of nitrogen on the basis of increase in crop rather than on the basis of total product, they rank to date for the entire period of the experiment, 1890 to 1905, inclusive, as follows: —

Relative Increases in Yields (Average for the Sixteen Years).

	Per Cent.
Nitrate of soda,	100.00
Barnyard manure,	80.58
Dried blood,	68.72
Sulfate of ammonia,	60.78

Whatever the method of comparison, the superiority of the results obtained from the use of nitrate of soda is very apparent. In estimating the significance of the figures, the fact must not be lost sight of that the four different materials, nitrate, dried blood, sulfate of ammonia and barnyard manure, are applied in this experiment in amounts furnishing precisely equal quantities of nitrogen to each plot where they are used. At current prices, a pound of nitrogen can be purchased at lower cost in nitrate of soda than in almost any other material; and the advisability, therefore, of depending largely upon the nitrate as a means of supplying the important element nitrogen, becomes strikingly evident.

II. — The Relative Value of Muriate and High-grade Sulfate of Potash. (Field B.)

This experiment, which has been in progress since 1892, was designed to test the relative value of muriate and high-grade sulfate of potash used continuously upon the same soil. These salts since 1900 have been annually applied at the rate of 250 pounds each per acre. There are ten plots in the field, each containing about 1/7 of an acre. Five of these receive muriate of potash, and these plots alternate with the same number of plots which are yearly manured with sulfate of potash. Each plot in the field is manured annually with fine-ground bone at the rate of 600 pounds per acre. The crops grown in this field this year have included soy beans, celery, asparagus, rhubarb, raspberries, blackberries and clovers. The yields of the three crops, asparagus, raspberries and blackberries, have been small, and the differences in the results on the different potash salts did not appear to be sufficient to be of much significance. There was, however, a very marked difference in the extent to which the blackberry bushes on the two potash salts winter-killed. Those on the plot which has annually received an application of sulfate of potash were killed back much less seriously than the bushes on the muriate of potash plot. There was a marked difference in the growth of the celery on the two potash salts, that on the muriate being much better than that on the sulfate. This fact is reported at this time without comment, as it seems to the writer probable that some accidental cause, not connected directly with the system of manuring, unfavorably influenced the growth on the poorer plot. Six plots in the field have been in clover during the past year. All of these plots were sown to clover in the late summer of 1904, one pair of plots each (muriate and sulfate) with Alsike, Medium and Mammoth clovers. The clover on all plots germinated well, but early showed a very unhealthy condition on the plots occupied both by the Medium and Mammoth red clovers. The young plants early turned yellow and gradually disappeared. So poor was the condition of these varieties of clover this

spring that it was decided to plow them up. The unhealthy condition is thought to have been connected with a deficiency of lime in the soil, and these plots accordingly received an application of freshly slaked lime at the rate of about 1 ton to the acre. They were then plowed and reseeded to the same varieties of clover. The crops were cut on August 11, but, being much mixed with weeds, as was to be expected in the case of spring-sown clover, the product was not weighed. The Alsike clover upon the plots sown in the summer of 1904 gave one fair crop.

The yield on the muriate was at the rate of 3,986 pounds per acre; on the sulfate, 4,000 pounds. These figures do not accurately indicate the relative condition of the clover, for the growth on both plots was somewhat mixed with other grasses, which were much more abundant on the muriate of potash than on the sulfate, where the clover was very clearly much superior to that on the other plot. The rhubarb on both potash salts gave a heavy growth. The rates of yield per acre were as follows: —

Muriate v. High-grade Sulfate of Potash (Rhubarb). — Yields per Acre (Pounds).

FERTILIZERS USED.	Stalks.	Leaves.
Muriate of potash,	23,148	19,249
Sulfate of potash,	23,729	20,344

These yields are much heavier than last year, as the rhubarb is now more fully established, and the difference in favor of the sulfate of potash is still greater than previously.

III. — COMPARISON OF DIFFERENT POTASH SALTS FOR FIELD CROPS. (FIELD G.)

This experiment for comparison of different potash salts was begun in 1898. The field contains forty plots, of about one-fortieth of an acre each. The plots are fertilized in five series of eight plots each, each series including a no-potash plot and one plot for each of the potash salts under comparison. Those salts are kainite, high-grade sulfate, low-grade sulfate, muriate,

nitrate, carbonate and silicate. Each is applied annually to the same plot, and all are used in such amounts as to furnish equal potash to each plot. In the quantities employed the different salts supply annually actual potash at the rate of 165 pounds per acre. All plots are equally manured with materials furnishing fairly liberal amounts of nitrogen and phosphoric acid.[1]

The crops grown in this experiment since 1898 in order of succession up to the present year have been: —

1898. Medium Green soy beans.
1899. Potatoes.
1900. Plots 1–8, cabbage; 9–24, Medium Green soy beans; 25–40, cow peas.
1901. 1–8, wheat; 9–40, corn.
1902. Clover.
1903. Clover.
1904. 1–16, cabbage; 17–40, corn.
1905. Soy beans.

The results with the crops of last year, cabbages and corn, were rather indecisive, and were not reported in detail. The most striking observation in connection with the results of last year was the relatively low yields on the silicate of potash and the relatively high yields on the nitrate and carbonate. The crop in 1905 was the Medium Green soy bean. The season was favorable to the crop, which, with one exception, to be presently noted, appeared to be affected by no disturbing accidental conditions. A circular area, extending entirely across Plot 10 and a short distance into both plots 9 and 11, was early affected by some unknown cause, which within a relatively short time resulted in the death of the plants growing there. It is estimated that the total number of plants in Plot 10 thus destroyed was from one-quarter to one-third of the total number of plants in the plot. The proportion of plants destroyed in plots 9 and 11 was relatively small.

At a period very early in the growth of the crop it was noticed that the leaves on all the plots to which kainite is applied as a fertilizer were abnormal. Practically all the

[1] Sixteenth annual report, Hatch Experiment Station.

leaves on plants on these plots early became very much crinkled. They were smaller than normal leaves, and there were numerous areas near the margins of some of the leaves where the tissues died. This appearance was repeated with such perfect regularity on each one of the plots (2, 10, 18, 26, 34) to which kainite was applied that it is impossible to doubt that the effect was due to constituents found in this fertilizer. It was clearly physiological in its origin. Whether due to the large amounts of chlorides contained in the kainite applied to these plots we are not at present certain; but, in view of the fact that potassium chloride has in a number of instances been shown to be distinctly inferior as a source of potash for soy beans in comparison with other salts in our experiments, it seems probable that such was the case. The potash salts used on the different plots and the rates of yield of beans per acre are shown in the following table: —

Yields per Acre.

Plots.	Potash Salt.	Beans (Bushels).	Straw (Pounds).
1,	No potash,	24.14	2,120
2,	Kainite,	18.62	1,210
3,	High-grade sulfate,	26.90	2,000
4,	Low-grade sulfate,	25.17	1,800
5,	Muriate,	22.41	1,640
6,	Nitrate,	24.14	1,960
7,	Carbonate,	32.41	2,280
8,	Silicate,	22.07	1,540
9,	No potash,	18.79	1,400
10,	Kainite,	11.38	1,600
11,	High grade sulfate,	21.04	2,080
12,	Low-grade sulfate,	22.42	2,280
13,	Muriate,	22.07	2,240
14,	Nitrate,	25.87	2,800
15,	Carbonate,	28.28	2,700
16,	Silicate,	26.90	2,740
17,	No potash,	24.83	2,380
18,	Kainite,	17.24	1,540
19,	High-grade sulfate,	25.52	1,940
20,	Low-grade sulfate,	24.14	1,760

Yields per Acre — Concluded.

Plots.	Potash Salt.	Beans (Bushels).	Straw (Pounds).
21,	Muriate,	30.69	1,820
22,	Nitrate,	26.21	2,160
23,	Carbonate,	26.90	2,260
24,	Silicate,	26.21	2,080
25,	No potash,	22.41	1,780
26,	Kainite,	19.31	1,240
27,	High-grade sulfate,	31.72	2,080
28,	Low-grade sulfate,	25.87	1,760
29,	Muriate,	24.48	1,900
30,	Nitrate,	15.86	1,240
31,	Carbonate,	26.55	1,960
32,	Silicate,	23.19	1,600
33,	No potash,	23.45	1,800
34,	Kainite,	18.26	1,160
35,	High-grade sulfate,	24.14	1,820
36,	Low-grade sulfate,	16.21	960
37,	Muriate,	15.52	1,040
38,	Nitrate,	24.83	2,020
39,	Carbonate,	24.14	2,240
40,	Silicate,	28.62	2,160

The influence of the different potash salts is somewhat more clearly brought out by the table below, which gives the average results for each of the potash salts employed: —

Soy Beans. — Average Yield per Acre.

Potash Salt.	Beans (Bushels).	Straw (Pounds).
No potash (plots 1, 9, 17, 25, 33),	22.72	1,896
Kainite (plots 2, 10, 18, 26, 34),	16.96	1,350
High-grade sulfate (plots 3, 11, 19, 27, 35),	25.86	1,984
Low-grade sulfate (plots 4, 12, 20, 28, 36),	22.76	1,712
Muriate (plots 5, 13, 21, 29, 37),	23.03	1,728
Nitrate (plots 6, 14, 22, 30, 38),	23.38	2,036
Carbonate (plots 7, 15, 23, 31, 39),	27.86	2,288
Silicate (plots 8, 16, 24, 32, 40),	25.40	2,024

It will be noticed that the average rate of yield on all plots to which potash salts are applied, with the exception of those where kainite is the source of potash, is greater than on the no-potash plots. The average yield on the kainite, on the other hand, is much below the average on the no-potash plots. Examination of the longer table shows that this inferiority of kainite was constant for each of the five plots. Such examination also shows that the variation in relative standing of the plots where each of the different potash salts was used is fairly constant for each. The most marked exception to this rule is found in the case of plots 30, 36 and 37, where the yields are lower than on other plots receiving the same potash salts. This inferiority on these plots appears to have been due to the fact that the stand of plants in them was too thin. A count indicates that the average number of plants in a row in this field is about 120; in Plot 30 it was about 95; in plots 36 and 37 about 45. The potash salt giving the highest yield in this experiment is the carbonate, followed closely by the high-grade sulfate and silicate. The potash salts, other than kainite, containing chlorine (low-grade sulfate and muriate), give yields considerably lower. As neither the carbonate nor the silicate of potash is commonly found in our markets, these having been manufactured in the first instance as fertilizers for tobacco, the practical lesson to be drawn from the experiment is that for the soy bean it is much safer to depend upon the high-grade sulfate as a source of the needed potash than to use any of the potash salts containing chlorine. Neither the carbonate nor the silicate, even if available, would be preferable to the high-grade sulfate, as the cost per unit of potash is much greater than with sulfate. The result of the past season is in agreement with results obtained with this crop in a considerable number of earlier experiments, and it seems impossible to doubt the validity of the conclusion above stated. The advice, therefore, is most strongly given, that, on all soils at least with good retentive qualities and moisture, the sulfate of potash should generally be preferred to muriate or kainite, not only for soy beans, but for clovers and with little doubt for all other legumes as well.

IV. — Special Fertilizer *v.* Fertilizer Richer in Potash.

This experiment has been in progress since 1891. It occupies an acre of ground, divided into four equal plots. The crop from 1891 to 1896, inclusive, was corn; in 1897 and 1898 the crop was mixed grass and clover; in 1899 and 1900 it was corn; in 1901 and 1902, grass and clover; in 1903 and 1904, corn. The land was seeded in the corn in late summer, 1904. The crop harvested this year is hay, — mixed timothy, red-top and clover. The object in this experiment is to test the question whether the special corn fertilizers offered in our markets are of such composition as is best suited for the production in rotation of corn and mixed hay. The plots are numbered from 1 to 4. Plots 1 and 3 yearly receive an application of fertilizers furnishing the same amount of nitrogen, phosphoric acid and potash as would be furnished by 1,800 pounds of fertilizer of the composition of the average of the special corn fertilizers analyzed at this station. This average has changed but little during recent years, and in 1899, since which date we have made no change in the kinds and amounts of fertilizers used, was as follows: —

	Per Cent.
Nitrogen,	2.37
Phosphoric acid,	10.00
Potash,	4.30

The fertilizers used on plots 2 and 4 are substantially the same in amount and kind as recommended in Bulletin No. 58 of this station for corn on soils poor in organic matter. The essential difference in composition between the fertilizer mixtures under comparison is that the mixture used on plots 2 and 4 is richer in potash and much poorer in phosphoric acid than the mixture representing the average market corn fertilizers. The fertilizers applied to the several plots are shown below: —

Fertilizers used.	Plots 1 and 3 (Pounds Each).	Plots 2 and 4 (Pounds Each).
Nitrate of soda,	30.0	50.0
Dried blood,	30.0	-
Dry ground fish,	37.5	50.0
Acid phosphate,	273.0	50.0
Muriate of potash,	37.5	62.5

The following tables show rates of yields per acre of both hay and rowen on the several plots, and the averages for the two systems of manuring: —

Yields per Acre (Pounds).

Plots.	Hay.	Rowen.
Plot 1 (lesser potash),	3,960	240
Plot 2 (richer in potash),	3,900	360
Plot 3 (lesser potash),	3,720	400
Plot 4 (richer in potash),	3,720	300

Average Yields per Acre (Pounds).

Plots.	Hay.	Rowen.
Plot 1 and 3 (lesser potash),	3,840	320
Plots 2 and 4 (richer in potash),	3,810	330

It will be noticed that the yields under the two systems of manuring, both in hay and rowen, are substantially equal. At current prices, the cost per acre of the fertilizers used on plots 2 and 4 is about $5 less than the cost of the materials used on plots 1 and 3. As we have secured equal crops at a materially lower price, the advantage is clearly with the fertilizer combination richer in potash.

V. — Manure alone *v.* Manure and Potash.

By way of description of this experiment, I cannot do better than to quote from the seventeenth annual report: —

These experiments, which have for their object to show the relative value as indicated by crop production of an average

application of manure used alone, as compared with a smaller application of manure used in connection with a potash salt, were begun in 1890. The field used is level, and the soil of comparatively even quality. It is divided into four quarter-acre plots. The crop grown during the years 1890 to 1896, 1899 and 1900, 1903 and 1904, has been corn. In 1897 and 1898, and again in 1901 and 1902, the crop was mixed grass and clover. Where manure is used alone, it is applied at the rate of 6 cords per acre. Where manure is used with potash, the rates of application are: manure, 4 cords; high-grade sulfate of potash, 160 pounds per acre. Manure alone is applied to plots 1 and 3; the lesser quantity of manure and high-grade sulfate of potash to plots 2 and 4. Estimating the manure alone as costing $5 per cord, applied to the land, the money difference in the cost of the materials applied is at the rate of $6.40 per acre, the manure and potash costing that amount less than the larger quantity of manure alone.

Mixed timothy, red-top and clover was sown in late summer in the standing corn of last year. The following tables show the rates of yield on the several plots and the averages under the two systems of manuring: —

Yields per Acre, 1905 (Pounds).

Plots.	Hay.	Rowen.
Plot 1 (manure alone), ...	6,720	1,840
Plot 2 (manure and potash), ...	5,820	1,200
Plot 3 (manure alone), ...	6,120	1,720
Plot 4 (manure and potash), ...	8,580	1,640

Average Yields per Acre (Pounds).

Plots.	Hay.	Rowen.
Plots 1 and 3 (manure alone), ...	6,420	1,780
Plots 2 and 4 (manure and potash), ...	7,200	1,420

It will be noticed that the average yield on the two plots receiving the smaller quantity of manure and potash is somewhat greater than on the other two plots. Since this com-

bination (4 cords of manure and 160 pounds muriate of potash) costs $6.40 per acre less than the 6 cords of manure, the advantage is decisively in favor of the combination.

VI. — Experiment in the Application of Manure.

This experiment was begun in 1899, and is to be continued for a series of years. It is designed to throw light upon the question as to whether it is economically good policy to spread manure during the late fall and winter and allow it to remain on the surface until spring before plowing under. This method of application is compared with the plan of hauling manure from the stable to the field during the winter and putting it into large compact heaps, from which it is hauled and spread just before plowing in spring. The field in which this experiment is tried slopes moderately to the west. In further description I quote from the seventeenth annual report: —

To insure even quality of the manure used in the two systems, it is our practice to manure two plots at one time, putting the loads of manure as hauled to the field alternately upon the two, in the one case spreading, but in the other putting a sufficient number of loads to provide for the entire plot into one large heap. We are using in this experiment five large plots, each of which is subdivided into two subplots. For one of these subplots the manure is spread when hauled out, for the other it is put into a large heap. The area of these subplots is about one-quarter of an acre, and to each the amount of manure applied is 11,096 pounds. The manure from well-fed milch cows is used upon eight subplots, and horse manure on two. The manure used in this experiment is applied at different dates during the winter, our practice being to allow the manure to accumulate in the pits from which it is taken until there is a sufficient quantity for at least two subplots. The condition of the soil at the time of application and the nature of the weather which follows must necessarily differ in the different experiments; and these differences, together with the difference in the dates of application above referred to, no doubt in a measure account for the variation in the results of the two systems noticed on the different plots.

The crop raised in this field last year was mixed corn and soy beans for ensilage. After the harvest of this crop the field was well harrowed and sown to rye. This crop, which was intended for cover, germinated but poorly and made only a feeble growth. The crop of 1905 was corn, — a number of different varieties received for comparison from the United States Department of Agriculture, and Sibley's Pride of the North of our own growing. These varieties were so arranged that each plot and subplot had equal areas of each. The soil was thoroughly prepared by plowing and harrowing, and the seed was sown on May 19. Soil and seasonal conditions were favorable, and the growth was uninfluenced, so far as could be recognized, by accidental conditions. A number of varieties sown showed relatively low productive capacity, and the final yield was lower than is usual in this section on well-manured land of similar quality. The rates of yield per acre and the relative standing of the several plots are shown in the following tables: —

Corn and Stover. — Actual Yields (Rates per Acre).

Plots.	North Half, Winter Application.			South Half, Spring Application.		
	Stover (Pounds).	Hard Corn (Bushels).	Soft Corn (Bushels).	Stover (Pounds).	Hard Corn (Bushels).	Soft Corn (Bushels).
1, ...	7,347	31.51	3.21	7,862	32.16	2.45
2, ...	7,150	25.96	2.99	7,763	32.08	4.00
3, ...	6,806	22.13	4.36	7,713	27.25	3.53
4, ...	7,447	24.44	3.06	8,309	29.20	2.85
5, ...	7,637	30.46	2.34	8,026	32.48	2.31

Corn and Stover. — Relative Yields (Per Cent.).

Plots.	North Half, Winter Application.		South Half, Spring Application.	
	Stover.	Hard Corn.	Stover.	Hard Corn.
1, ...	100	100	107.0	102.1
2, ...	100	100	108.6	123.6
3, ...	100	100	113.3	123.1
4, ...	100	100	111.6	119.5
5, ...	100	100	105.1	106.4

It will be noticed that in every instance spring manuring has given a larger yield both of stover and of hard corn than winter application. This result is in general agreement with those of earlier years, but the differences as indicated by the relative yields are comparatively small. The winter of 1904 and 1905 was characterized by uniform temperatures, fairly deep and continuous snow cover and absence of thaws. Such conditions are of course favorable to winter application, and the above-mentioned peculiarities of season perhaps account for the smaller relative differences in yield this year.

The system of manuring designated as spring application involves, as will have been noticed by the reader, twice handling, while in winter application the manure is handled but once. Spring application, therefore, costs more than winter application. As the result of our experience, we estimate the money difference to amount to $4.80 per acre. The average difference in the value of crops this year in favor of spring application, estimating stover to be worth $5 per ton and the corn as husked 50 cents per bushel, amounts to only $3.49 per acre, — a sum insufficient to cover the increased cost of spring application. Even on Plot 3, where the difference in favor of spring application is greatest, the money difference in value of the crops on the same basis as before is only $4.81, which barely covers the increased cost of application. The results for this season, therefore, economically considered, indicate that spreading the manure as taken from the stable in the fall or winter is to be preferred.

VII. — Experiment in manuring Grass Land.

The plan of this experiment, which has continued now for thirteen years, will be made clear by quoting from the sixteenth annual report: —

In this experiment, which has continued since 1893, the purpose is to test a system of using manures in rotation for the production of grass. The area used in the experiment is about 9 acres. It is divided into three approximately equal plots. The plan is to apply to each plot one year barnyard manure,

the next year wood ashes, and the third year fine-ground bone and muriate of potash. As we have three plots, the system of manuring has been so arranged that every year we have a plot illustrating the results of each of the applications under trial. The rates at which the several manures are employed are as follows: barnyard manure, 8 tons; wood ashes, 1 ton; ground bone, 600 pounds; and muriate of potash, 200 pounds, per acre. The manure is always applied in the fall; ashes and the bone and potash in early spring.

The past season has been rather unfavorable for the production of large yields of hay, as there was a considerable deficiency in both spring and summer rainfall. The yields of hay and rowen and the total yields for each system of manuring were at the following rates per acre: —

Fertilizers used.	Hay (Pounds).	Rowen (Pounds).	Totals (Pounds).
Barnyard manure,	3,738	1,210	4,948
Bone and potash,	3,326	1,249	4,575
Wood ashes,	3,816	1,047	4,863

The average yield of the entire area this year was 4,840 pounds per acre. The average yield of the entire area from 1893 to 1904, inclusive, has been 6,718 pounds per acre. The average yield from 1893 to 1905, inclusive, has been 6,479 pounds per acre. The average yields under the different systems of top-dressing have been as follows: —

	Pounds per Acre.
When top-dressed with manure,	6,866
When top-dressed with wood ashes,	6,193
When top-dressed with bone and potash,	6,524

It will be noticed that the average yields of the entire area for this year are much below similar averages for the period.

VIII. — Nitrate of Soda for Rowen.

For the past five years we have been experimenting in one of our fields for the purpose of determining whether nitrate of soda applied soon after the first crop is cut will

give a profitable increase in the rowen crop. The field where this experiment has been tried was seeded to pure timothy in the fall of 1897. The growth is now considerably mixed with clover, which has been gradually coming in. The whole field is uniformly fertilized for the first crop. The materials applied are usually put on in early spring at the following rates per acre: nitrate of soda, 150 pounds; muriate of potash, 200 pounds; fine-ground bone, 400 pounds. This application usually gives us a good crop. The area of the field is a little more than 3 acres. The rate of yield in the first crop this year was 4,471 pounds of well-cured hay per acre. In this field eight equal plots, containing almost exactly ⅓ acre each, have been laid out. Alternate plots in the series of eight receive annually a top-dressing of nitrate of soda. For the past two years, in order that the nitrate may be more uniformly spread, we have mixed the quantity to be applied to each plot with sufficient basic slag meal to constitute an application at the rate of 400 pounds per acre. To equalize conditions on the alternate plots to which no nitrate is applied, the basic slag meal is applied to all of these at the same rate. The rates of application for the fertilizers on the several plots per acre and the yields are shown in the table:—

Nitrate of Soda for Rowen.

Plots.	Fertilizers used (Rates per Acre).	Yield (Pounds).	Increase per Acre (Pounds).
1, . . .	Slag meal, 400 pounds, ...	975	-
2, . . .	Slag meal, 400 pounds; nitrate of soda, 150 pounds.	1,127	228
3, . . .	Slag meal, 400 pounds, ...	822	-
4, . . .	Slag meal, 400 pounds; nitrate of soda, 150 pounds.	1,036	305
5, . . .	Slag meal, 400 pounds, ...	640	-
6, . . .	Slag meal, 400 pounds; nitrate of soda, 200 pounds.	1,340	486
7, . . .	Slag meal, 400 pounds, ...	1,067	-
8, . . .	Slag meal, 400 pounds; nitrate of soda, 250 pounds.	3,009	1,942

It will be noticed that the nitrate of soda wherever applied has given an increase in the crop. This increase is relatively small in all the plots except Plot 8, where it is at the rate of

nearly 1 ton per acre. During all the years that this experiment has been tried on this land it has been found that the yield on Plot 8 has been much the largest in the fall. True, this receives the heaviest application of nitrate, but it is not believed that the superiority in yield is entirely due to this difference. The moisture conditions are more favorable to growth during the late summer in this plot than in the others. During the five years that this experiment in the use of nitrate of soda for the rowen crop has been tried on this field, it has seemed to give increases sufficient to make the application profitable only in two trials; and, on the whole, the results of our experiments are not favorable to the conclusion that it will usually be found profitable to use nitrate of soda for the rowen crop. The soil in this field is a strong and retentive loam. It is, of course, quite possible that on soils of different character the results of the use of nitrate for rowen will be more favorable.

IX. — Fertilizers for Garden Crops. (Field C.)

In this experiment the principal object in view is to study the effect of some of the standard fertilizing materials upon the yield and quality of garden crops. During the earlier years of the experiment, 1891 to 1897 inclusive, fertilizers alone were applied to the land. It was then decided that, since market gardeners as a rule employ large quantities of manure, the value of the experiment to those engaged in that branch of agriculture would be increased by applying manure equally to all the plots, while still continuing the application of fertilizers. During the earlier years of the experiment there were but six plots, on all of which fertilizers were used. With the change in system alluded to a seventh plot was introduced, and to all of the seven plots stable manure at the rate of 30 tons per acre has since been annually applied. It is intended that the seventh plot, on which manure alone is applied, shall serve as a basis of comparison with the others, in order that we may learn whether, and, if so, to what extent, any fertilizers prove beneficial. The seventh plot immediately adjoins the others, but previous to its inclusion in this experiment it

had been manured somewhat differently. For the first few years the product on manure alone on this plot exceeded the product with equal manure and fertilizers on the other plots. This initial superiority is gradually disappearing, and the product of most of the crops where the fertilizers as well as manure are used now exceeds that upon the seventh plot, where manure only is used. It is possible that the seventh plot does not even yet serve as a fair basis for comparison; but the following crops on most of the plots, where fertilizers in addition to manure are used, have given yields sufficiently greater than those produced where manure alone is used to much more than pay for the cost of the fertilizers, viz.: asparagus, rhubarb, peas, squashes, tomatoes and table beets. It should be pointed out, however, that such increase was in most cases very small where sulfate of ammonia is one of the fertilizer materials used. Indeed, with asparagus the combination of manure and fertilizers containing sulfate of ammonia gave a smaller yield than manure alone. With tomatoes the increased yield was mainly confined to green fruit. The fertilizers did not materially increase the yield of ripe fruit as compared with the yield obtained on manure alone. Some crops showed no increase at all on the plots where fertilizers were added to the manure. Among these were celery and turnips, while cabbages gave either no increase at all or one which was insignificant.

Practically all important out-door garden crops have been grown in rotation upon each plot, and each crop during several years. The crops so far grown are as follows: spinach, lettuce, onions, garden peas, table beets, early and late cabbages, potatoes, tomatoes, squashes, cucumbers, turnips, sweet corn, celery and strawberries. One row each of asparagus and rhubarb was set in each plot in 1902. The first cuttings were made last year.

As stated in my last annual report, these "experiments have been planned with reference to throwing light especially upon two points: *A*. The relative value of nitrate of soda, sulfate of ammonia, and dried blood used as sources of nitrogen. *B*. The relative value of sulfate of potash and muriate of potash. These two points will be separately discussed."

A. — The Relative Value of Nitrate of Soda, Sulfate of Ammonia and Dried Blood as Sources of Nitrogen.

The three fertilizers under consideration have from the first been applied in such amounts as to furnish nitrogen at the rate of 60 pounds per acre to each plot. Each fertilizer is always applied to the same plot. To furnish 60 pounds of nitrogen, the application of the fertilizers at about the following rates per acre is required: —

	Pounds.
Nitrate of soda,	375
Sulfate of ammonia,	300
Dried blood,	650

Each of these fertilizers is used on two plots, on one of which the source of the potash is the sulfate, on the other the muriate, in both cases in such quantities as to furnish equal actual potash. In addition to the nitrogen and potash fertilizers, dissolved boneblack is applied at the rate of 320 pounds per acre to all plots. The amount of actual potash applied is at the rate of 120 pounds per acre; the amount of actual phosphoric acid at the rate of 50.4 pounds per acre. The source of the potash used affects the results on some of the crops in a marked degree. This is especially the case where sulfate of ammonia is the source of nitrogen.

The results obtained previous to this year may be summarized as follows: —

For the early crops, *i.e.*, the crops making most of their growth before mid-summer, including onions, lettuce, table beets, garden peas, spinach, early cabbages and strawberries, the nitrate of soda has been found the most effective source of nitrogen.[1]

The relative standing of the different nitrogen fertilizers, as measured by the total yields, including leaves, vines and tops, as well as the marketable product, is as follows for the early crops: —

	Per Cent.
Nitrate of soda,	100.00
Dried blood,	95.64
Sulfate of ammonia,	60.95

[1] Sixteenth annual report, Hatch Experiment Station, p. 124.

For the late crops, including late cabbages, celery, tomatoes, turnips and squashes: —

	Per Cent.
Nitrate of soda,	100.00
Dried blood,	98.88
Sulfate of ammonia,	78.74

The relative average standing of the sulfate and muriate of potash, as indicated by the total yield of all crops grown in Field C previous to this year, is shown in the following table: —

Fertilizers used.	Early Crops (Per Cent.).	Late Crops (Per Cent.).
Sulfate of potash,	100.00	98.32
Muriate of potash,	94.04	100.00

For the past year the relative standing of the nitrogen fertilizers for the early crops, including asparagus, rhubarb, strawberries, peas and table beets, is as follows: —

	Per Cent.
Nitrate of soda,	100.00
Dried blood,	96.11
Sulfate of ammonia,	92.83

For the late crops, including cabbages, celery, tomatoes, turnips and squashes, the relative standing is: —

	Per Cent.
Nitrate of soda,	100.00
Dried blood,	97.22
Sulfate of ammonia,	90.51

Combining the results for 1905 with the fourteen previous years, the relative standing of the nitrogen fertilizers is: —

For the early crops: —

	Per Cent.
Nitrate of soda,	100.00
Dried blood,	95.67
Sulfate of ammonia,	63.08

For the late crops: —

	Per Cent.
Nitrate of soda,	100.00
Dried blood,	98.77
Sulfate of ammonia,	79.52

The relative standing of the potash salts for the present year is: —

For the early crops: —

	Per Cent.
Sulfate of potash,	96.52
Muriate of potash,	100.00

For the late crops: —

	Per Cent.
Sulfate of potash,	92.08
Muriate of potash,	100.00

Combining the relative standing of the potash salts for 1905 with the figures indicating relative standing for the fourteen previous years, the relative standing is: —

For the early crops: —

	Per Cent.
Sulfate of potash,	100.00
Muriate of potash,	94.66

For the late crops: —

	Per Cent.
Sulfate of potash,	97.90
Muriate of potash,	100.00

The results of the experiments for this year will not be reported in detail. The following points are worthy of mention: —

1. Nitrate of soda appears to be the best source of nitrogen for asparagus, table beets, cabbages and squashes.

2. Dried blood as the source of nitrogen has given the largest crops in the case of strawberries, peas, tomatoes and celery.

3. Sulfate of potash as the source of potash seems to be superior for asparagus, peas, beets and cabbages.

4. Muriate of potash gives results superior to those obtained with the sulfate for rhubarb, strawberries, squashes, tomatoes and celery.

5. Sulfate of ammonia for practically all crops appears to have been the poorest material used as a source of nitrogen.

X. — Alfalfa.

Our experiments with alfalfa have been continued both upon our own grounds and those of a few selected farms in different parts of the State. We are bringing to bear upon these experiments information in regard to successful methods from every possible source. We find in all cases a distinct benefit from a heavy initial application of lime. We have used from 2,000 to 3,000 pounds per acre. We are enriching soils already naturally good by heavy applications both of manures and fertilizers, using materials which experience has proved best. We are also giving the soil a most thorough preparatory tillage. It has usually been fall-plowed, and in addition it is plowed in the spring, and repeatedly harrowed to destroy weeds which start in the early part of the season. We have tried inoculating the soil both with earth obtained from a field in New York, where alfalfa is successfully grown, and with the cultures sent out by the Department of Agriculture and prepared by private firms. We have not attained such degree of success as justifies us in recommending the crop. We have occasionally got a fair stand of alfalfa, but in all cases the winters prove more or less injurious. In the course of a few years the alfalfa is mostly crowded out by grasses and clovers. The alfalfa almost every year suffers from leaf spot, which tends to cut down the yield.

We have found a very distinct benefit from the inoculation with earth from the New York alfalfa field. We have not found an equally distinct benefit to follow inoculation with any of the cultures; and, although we are not as yet ready to make a final report, it should be here remarked that the most careful experiments on the use of these cultures in sterilized soils, under conditions calculated to give accurate results, indicate that they have little if any value.

In our various experiments alfalfa has been tried on a wide variety of soils. We have had a quarter of an acre field upon a coarse-textured soil upon a farm in this neighborhood where there is never any standing water within 50 to 60 feet of the surface. Even on this soil the alfalfa,

although it did fairly well for a year, has been injured by successive winters, until it is at the present time almost ruined.

In this connection I call attention further to the fact that Mr. D. S. Bliss of the Department of Agriculture, who has been making special efforts to promote the introduction of alfalfa into New England, and who has travelled extensively for the purpose of studying the results obtained, now speaks very discouragingly as to the outlook in general.

In conclusion, while we are not inclined to discourage experiments with alfalfa, we do wish most emphatically to caution against engaging in these experiments upon an extended scale, for we feel that disappointment is almost inevitable.

XI. — Poultry Experiments.

Our work with poultry during the past year has had the same general purpose in view as in former years, namely, to throw light on the question of the proper selection of feeds for laying fowls. The fowls used in the experiments were pullets of our own raising, and matched flocks have been kept, as in former years, each in a house by itself, all the houses being of precisely similar dimensions and construction.

1. The two flocks in houses Nos. 1 and 2 have been fed on rations characterized by high content both of ash and fat and low fiber. The deficiency of wheat in fat as compared with corn is made up in the ration fed to the fowls in House No. 1 by the use of corn oil, the total amount of fat in the foods used being substantially the same for the two rations. This experiment, therefore, in a general way affords opportunity to test the relative value for egg production of wheat and corn. The ration fed the fowls in House No. 1 contains a relatively high percentage of protein, and has a narrow nutritive ratio. The ration used in House No. 2 contains a relatively low percentage of protein, and has a wide nutritive ratio. The animal food used in both these rations was beef scraps. The following results were obtained: for the first period, March 2 to May 12, inclusive, the wheat ration produced eggs at the average rate of .39 per hen day, the

corn ration at the rate of .45 per hen day; in other words, 100 hens would have laid 39 eggs per day on the wheat ration and 45 eggs per day on the corn ration. For the second period, May 13 to September 23, inclusive, the wheat ration produced an average of .31 eggs per hen day, the corn ration at the rate of .41 eggs per hen day; in other words, during the summer period 100 hens would have laid 31 eggs per day on the wheat ration and 41 eggs per day on the corn ration. The average food cost per egg produced was: for the wheat ration 1.036 cents, for the corn ration .749 cents, for the first period; while for the second period the cost per egg on the wheat ration was .895 cents and for the corn ration .703. The gross cost of the food on the wheat ration varied from about .26 cents to .37 cents per day for each fowl; while on the corn ration the cost varied from .27 cents to .30 cents per day. The number of eggs on the corn ration was considerably greater than on the other, and the cost per egg was much smaller. This result is in agreement with the results of most of the similar experiments which we have tried in earlier years. We are certainly justified in the conclusion that corn has superior merits for egg production as compared with wheat.

2. The rations fed to the fowls in pens Nos. 3 and 4 were characterized by relatively high ash and low fiber content. Milk albumen was used as the source of animal food on account of the low percentage of fat it contains; and the rations fed to the fowls in both of these pens were characterized by much lower fat content than the rations fed to the fowls in pens Nos. 1 and 2. As in the first set of comparisons, the fat content of the two rations used in pens Nos. 3 and 4 was equalized by the addition of corn oil to the one naturally lower in fat. In this experiment, as in the first, wheat was the leading whole grain in the ration fed to the fowls in one house (No. 3); corn the leading whole grain used in the other house (No. 4). The results with the fowls in these houses, like the results obtained in houses Nos. 1 and 2, afford a basis for estimating the relative value of wheat and corn, but with a relatively low percentage of fat in both. The egg product in this experiment was as fol-

lows: for the first period, March 3 to May 12, inclusive, the wheat ration produced eggs at the average rate of .41 per hen day, the corn ration .39 per hen day; or, in other words, 100 hens would have laid on the wheat ration 41 eggs, on the corn ration 39 eggs, per day. For the second period, May 13 to September 23, inclusive, the wheat ration gave an average of .35 eggs per hen day, the corn ration .31; or, in other words, respectively for the wheat ration, an average of 35 eggs per hundred hens daily, and for the corn an average of 31 eggs. The food cost of the eggs in this experiment was as follows: for the wheat ration during the summer period, .845 cents per egg; for the spring period, 1 cent per egg. For the corn ration, the food cost per egg was .871 cents for the summer period; .942 cents for the spring period. The cost of food per hen daily on the wheat ration varied from .273 to .372 cents; for the corn ration, from .248 to .333 cents. In this experiment the wheat ration gave a somewhat better egg yield than corn, but at a higher average cost per egg. The experiment indicates, therefore, that, unless the fat content of the ration is relatively high, the more starchy foods are not sufficient to produce a satisfactory egg yield, and the product falls below that obtained from feeding a ration higher in protein.

3. The fowls in houses Nos. 5 and 6 were fed rations in both cases characterized by low protein, high ash and high fat content, the deficiency of fat in the grains selected being made up by the use of corn oil. The fowls in Pen No. 5 were fed grains, including oats and oat feed, characterized by a high proportion of fiber. Those in Pen No. 6 were fed grains among which rice was prominent, characterized by a low percentage of fiber. The experiment in these houses, then, was calculated to throw light upon the influence of fiber on egg production, the nutritive ratio in the two houses being substantially the same, — about 1 to 6.5. In these houses beef scraps was the animal food used. The results were as follows: For the period March 2 to May 12, inclusive, the egg production was: for the oat ration (high fiber) .40 eggs per hen day, for the rice ration (low fiber) .42 eggs per hen day; or, in other words, from 100 hens

daily respectively 40 and 42 eggs. For the second period, May 13 to September 23, inclusive, the averages were: on the oat ration .38 eggs per hen day, on the rice ration .46 eggs per hen day; or, from 100 hens daily respectively 38 and 46 eggs. The food cost of the eggs has been as follows: for the oat ration during the first period 1.019 cents, for the second period .935 cents; for the rice ration for the first period 1.103 cents, for the second period 1.048 cents. The cost of food per hen per day has varied for the oat ration from .32 to .40 cents; for the rice ration from .412 cents to .423 cents per day. The rice ration, as last year, has given a very satisfactory yield of eggs, but, as was then stated, its high price at the present time renders it poor economy to use it. We are employing it in these experiments because it contains less fiber than any other grain, and we are trying to throw light upon the influence of fiber in egg production. The indication this year, as last, is very clear that this influence is unfavorable.

The nutritive ratios in the food combinations used in the different experiments of the past year have been as follows: for the rations where wheat is compared with corn with beef scraps for animal food and high fat content, — for the wheat ration, between 1 to 4.57 and 4.26; for the corn ration, between 1 to 6.69 and 5.81; for the experiment in which wheat is compared with corn with milk albumen and beef scraps for animal food, — for the wheat ration, between 1 to 4.03 and 4.54; for the corn ration, 1 to 6.28 and 5.84; in the experiment in which oats and rice have been compared with high fat content, — for the oats, between 1 to 5.88 and 6.49; for the rice, between 1 to 5.84 and 6.53.

Our experiments clearly do not support the view that a narrow nutritive ratio is essential to good egg production.

REPORT OF THE HORTICULTURIST.

F. A. WAUGH.

The work of the division of horticulture for the past year has followed the lines announced in previous reports. It has been concerned chiefly with the propagation of plants, more especially dwarf fruit trees, with problems in pruning, and with the systematic study of varieties. During the year some interesting experiments in the growing of mushrooms have been under way. There follows herewith a report of progress in the experiments in pruning peach trees of bearing age.

PRUNING PEACH TREES.

A year ago this department made a report on experiments in pruning peach trees.[1] Another year has thrown new evidence on the problems involved, so it seems best to take up the subject again. In the mean time the trees have borne a considerable crop of fruit, and their behavior under this load has been particularly interesting.

Last year's report dealt with various problems, one of which was the practice of pruning frozen peach trees to help their recovery. Briefly stated, the experiment comprised four methods of treatment, as follows: (*a*) no pruning; (*b*) moderate pruning; (*c*) severe heading back; (*d*) cutting back to stubs, or "dehorning." The results of these various methods of pruning, as developed up to the time of making last year's report (December, 1904), showed that moderate pruning was to be preferred. It may be said at once that this general conclusion stands without much modification, though the severely pruned trees made a relatively better showing under the stress of a good crop of fruit.

[1] Hatch Experiment Station, seventeenth annual report, p. 162 (1905).

Perhaps the fact most obviously developed by the year's experience is that the trees were more severely injured by the freezes of 1902–03 and 1903–04 than had been supposed. From week to week one tree after another broke down or split down or lost large branches, through the stress of winds or growing fruit crop. As each successive tree broke down, it was plainly to be seen that the wood had been seriously injured by freezing, and that it had not recovered. Though the tree kept on growing, adding fresh and healthy outer layers of wood, the interior was dead and decaying. In many cases this decay was serious, and had extended through considerable areas of tissue. Many fungi (mostly saprophytes such as feed on dead wood) had gained a foothold, and seemed to be out-thriving the peach trees.

These evidences of decay, especially the larger fungi (polypori, etc.), were most conspicuous on the "dehorned" trees. A few of these trees have finally succumbed during the summer of 1905, and it is now plainer than it was a year ago that this method of treating severely frozen peach trees is not to be recommended. An additional drawback lay in the fact that the trees bore little or no fruit in 1905, while all the other trees in the experiment bore a good crop.

Perhaps a word of explanation should be added to this statement of the case. This method of pruning peach trees back to mere stubs has its uses, as in renewing the head when a tree is to be rebudded to a new variety. It can be successfully carried out, but only on vigorous and comparatively young trees. Trees weakened by freezing are precisely the ones which cannot respond to such vigorous treatment.

Coming next to the trees severely headed back (from which practically all the one-year-old wood was removed in the spring of 1905), we find conditions much better. There are some manifest evidences of the injury received during the freezes of two and three winters ago, some broken limbs and some growth of saprophytic fungi; but the trees show strong, sturdy tops, with a very satisfactory annual growth for 1905. The trees bore a good crop of fruit in 1905, and are in the best condition of any in the orchard for carrying

another crop in 1906. While trees severely headed back recovered less readily from the effects of freezing, those which finally bore the crop made distinctly better growth for the pruning.

The trees lightly pruned were cut back only a part of the previous year's annual growth, — from one-third to one-half. The largest percentage of recovery was shown by these trees, and they bore slightly larger crops of fruit in 1905 than any of the others. On the other hand, there appeared to be more breakage of large branches, the heads are left in less satisfactory form than on trees severely headed back, and the prospect for carrying a good crop in 1906 seems to be slightly less.

The trees left without pruning are now distinctly the poorest in the orchard, with the exception only of those that were "dehorned." The percentage of loss was high, the crop of 1905 was inferior to that on the pruned trees, and the present condition of these trees is unsatisfactory.

As the result of this experiment, the following practice would seem to be indicated: —

1. Prune peach trees moderately, removing not more than one-third to one-half the previous year's annual growth, when the wood has been injured by freezing.

2. When only the fruit buds are killed, the wood being uninjured and the trees in good condition, prune severely, cutting back the annual growth to two or three buds. It may be expedient to cut some branches back even into two or three year old wood.

REPORT OF THE CHEMIST.

DIVISION OF FERTILIZERS AND FERTILIZER MATERIALS.[1]

CHARLES A. GOESSMANN.
Assistants: HENRI D. HASKINS, EDWARD G. PROULX, E. T. LADD.

PART I. — Report on Official Inspection of Commercial Fertilizers.
PART II. — Report on General Work in the Chemical Laboratory.

PART I. — REPORT ON OFFICIAL INSPECTION OF COMMERCIAL FERTILIZERS AND AGRICULTURAL CHEMICALS DURING THE SEASON OF 1905.

CHARLES A. GOESSMANN.

The total number of manufacturers, importers and dealers in commercial fertilizers and agricultural chemicals who have secured licenses during the past season is 64; of these, 36 have offices for the general distribution of their goods in Massachusetts, 9 in New York, 6 in Connecticut, 3 in Vermont, 2 in Ohio, 1 in Rhode Island, 1 in Maryland, 1 in Tennessee, 1 in Arkansas, 1 in Missouri, 1 in Canada, 1 in New Jersey and 1 in Pennsylvania.

[1] See also tables in Appendix.

Three hundred and twenty-six brands of fertilizers and agricultural chemicals have been licensed in Massachusetts during the year. Five hundred and seventy-four samples of fertilizers have been collected up to the present time, in our general markets, by experienced assistants in the station. Five hundred and eleven samples had been analyzed at the beginning of December, 1905, representing 313 distinct brands of fertilizers. These analyses were published in two bulletins of the Hatch Experiment Station of the Massachusetts Agricultural College: No. 104, July; No. 107, November, 1905. The analyses of other officially collected samples of fertilizers not included in these two bulletins will be published in our next bulletin, in March, 1906. About the same number of fertilizers were licensed in Massachusetts during the year as in 1904. The results of our inspection work show 18 more samples analyzed during the season than for the previous year.

The following table gives a brief abstract of the results of analyses of the official commercial fertilizers in comparison with the year previous: —

	1904.	1905.
(*a*) Where three essential elements of plant food were guaranteed: —		
Number with three elements equal to or above the highest guarantee,	7	3
Number with two elements above the highest guarantee,	32	16
Number with one element above the highest guarantee,	111	83
Number with three elements between the lowest and highest guarantee,	190	203
Number with two elements between the lowest and highest guarantee,	146	138
Number with one element between the lowest and highest guarantee,	48	38
Number with three elements below the lowest guarantee,	none	1
Number with two elements below the lowest guarantee,	12	25
Number with one element below the lowest guarantee,	103	92
(*b*) Where two essential elements of plant food were guaranteed: —		
Number with two elements above the highest guarantee,	8	3
Number with one element above the highest guarantee,	16	29
Number with two elements between the lowest and highest guarantee,	20	13
Number with one element between the lowest and highest guarantee,	19	23
Number with two elements below the lowest guarantee,	1	5
Number with one element below the lowest guarantee,	15	21
(*c*) Where one essential element of plant food was guaranteed: —		
Number above the highest guarantee,	16	4
Number between the lowest and highest guarantee,	24	25
Number below the lowest guarantee,	13	19

From the above table it will be seen that the quality of the licensed fertilizers during the past year has not been up to the usual standard.

Trade Values of Fertilizing Ingredients in Raw Materials and Chemicals, 1904 and 1905 (Cents per Pound).

	1904.	1905.
Nitrogen in ammonia salts,	17.50	17.50
Nitrogen in nitrates,	16.00	17.00
Organic nitrogen in dry and fine-ground fish, meat, blood, and in high-grade mixed fertilizers,	17.50	18.50
Organic nitrogen in fine bone and tankage,	17.00	18.00
Organic nitrogen in coarse bone and tankage,	12.50	13.00
Phosphoric acid soluble in water,	4.50	4.50
Phosphoric acid soluble in ammonium citrate,	4.00	4.00
Phosphoric acid in fine-ground fish, bone and tankage,	4.00	4.00
Phosphoric acid in cotton-seed meal, castor pomace and wood ashes,	4.00	4.00
Phosphoric acid in coarse fish, bone and tankage,	3.00	3.00
Phosphoric acid insoluble (in water and in neutral citrate of ammonia) in mixed fertilizers,	2.00	2.00
Potash as sulfate, free from chlorides,	5.00	5.00
Potash as muriate (chloride),	4.25	4.25
Potash as carbonate,	–	8.00

A comparison of the market cost of the three essential elements of plant food for 1905 with the previous year shows the only variation to be in the various forms of nitrogen compounds: nitrogen in the form of nitrates, and the higher grades of organic nitrogen, including nitrogen in high-grade mixed fertilizers, is a cent higher per pound; while the medium and lower grades of organic nitrogen also show an increased cost of one-half cent per pound. All nitrogen compounds, with the exception of ammoniates, show somewhat of an increase in cost as compared with 1904.

The above schedule of trade values was adopted by representatives of the Massachusetts, Connecticut, Rhode Island, Maine, Vermont and New Jersey experiment stations at a conference held during the month of March, 1905, and is based upon quotations in the fertilizer market in centers of distribution in New England, New York and New Jersey during the six months preceding March, 1905, and refers to the current market prices, in ton lots, of the leading standard raw materials furnishing nitrogen, phosphoric acid and potassium oxide, and which go to make up our commercial fertilizers.

Table A, on the following page, gives the average composition of licensed fertilizers for 1905; Table B gives a compilation of analyses showing the average percentages, as well as the maximum and minimum percentages, of the three essential elements of plant food found in the so-called special crop fertilizers put out by the different manufacturers. This latter table shows how unsafe it is to be guided wholly by trade name when selecting a fertilizer for any special crop. Out of the several hundred fertilizers that are annually offered for sale in the general markets in Massachusetts, it becomes no easy matter for the farmer to select to meet his requirements in cases of the ready factory-mixed goods. No infallible rule can be laid down, as soil conditions vary so widely, and so much depends upon crop rotation. It is safe to say, however, that the higher-grade fertilizers are the most economical ones to buy. Those fertilizers should be purchased which furnish the most nitrogen, potash and phosphoric acid in a suitable and available form for the same money.

TABLE A. — *Average Analysis of Officially Collected Fertilizers for 1905 (Per Cent.).*

Nature of Material.	Moisture.	Nitrogen in One Hundred Pounds.		Phosphoric Acid in One Hundred Pounds.							Potassium Oxide in One Hundred Pounds.	
							Total.		Available.			
		Found.	Guaranteed.	Soluble.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.
Complete fertilizer,	10.79	2.74	2.66	4.24	3.63	2.42	10.24	9.13	7.87	7.07	5.11	4.81
Ground bone,	4.39	3.18	2.98	.15	10.47	14.75	25.16	26.80	10.62	6.00	-	-
Tankage,	9.91	5.82	5.54	.45	9.17	6.49	16.11	12.72	9.62	-	-	-
Dry ground fish,	9.13	9.75	8.21	-	5.14	3.15	6.52	7.43	5.14	-	-	-
Dissolved bone-black,	9.06	-	-	7.65	6.94	2.71	17.30	16.00	14.59	15.00	-	-
Dissolved bone,	10.56	2.81	3.00	1.02	9.12	6.02	16.16	18.00	10.14	13.00	-	-
Acid phosphate,	9.78	-	-	8.41	4.17	1.47	14.08	8.50	12.58	9.00	-	-
Wood ashes,	5.27	-	-	-	-	-	-	-	-	-	-	-
Cotton-seed meal,	6.06	6.70	7.64	-	-	-	1.51	1.00	-	-	5.33	4.40
Flax meal,	7.25	5.74	5.92	-	-	-	-	-	-	-	-	-
Nitrate of soda,	2.38	15.75	15.22	-	-	-	-	-	-	-	-	-
Sulfate of ammonia,	1.25	20.49	19.50	-	-	-	-	-	-	-	-	-
High-grade sulfate of potash,	3.06	-	-	-	-	-	-	-	-	-	49.66	49.42
Muriate of potash,	1.96	-	-	-	-	-	-	-	-	-	50.26	50.13
Dried blood,	9.20	10.11	9.50	-	-	-	1.66	-	-	-	-	-
Kainit,	1.52	-	-	-	-	-	-	-	-	-	12.79	12.00
Castor pomace,	8.26	5.27	4.74	-	-	-	-	-	-	-	-	-
Carbonate potash,	1.95	-	-	-	-	-	-	-	-	-	64.00	64.71
Vegetable potash,	2.85	-	-	-	-	-	-	-	-	-	23.96	25.00
Sulfate potash-magnesia,	1.25	-	-	-	-	-	-	-	-	-	20.56	26.00
Ground South Carolina phosphate,	.85	-	-	-	2.94	25.84	28.78	26.56	2.94	-	-	-

Table B. — *Compilation of Analyses of Commercial Fertilizers, Special Crop Brands, for the Year 1905 (Per Cent.).*

Name of Fertilizer.	Moisture.	Nitrogen in One Hundred Pounds.			Total Phosphoric Acid in One Hundred Pounds.			Available Phosphoric Acid in One Hundred Pounds.			Potassium Oxide in One Hundred Pounds.		
		Maximum.	Minimum.	Average.	Maximum.	Minimum.	Average.	Maximum.	Minimum.	Average.	Maximum.	Minimum.	Average.
Corn fertilizer,	11.11	3.87	1.02	2.03	16.24	8.32	11.17	12.92	4.70	8.58	12.27	1.74	4.06
Fruit and vine fertilizer,	11.69	3.00	2.16	2.48	10.88	7.60	9.39	9.78	4.68	7.32	11.68	6.20	8.08
Grass fertilizer,	7.57	8.86	1.33	4.19	16.24	4.76	8.94	10.74	2.58	6.54	12.27	1.74	5.72
Market-garden fertilizer,	9.97	4.85	1.84	3.19	13.22	5.04	9.93	10.74	2.58	7.59	12.50	2.02	6.51
Onion fertilizer,	11.11	3.87	1.02	2.03	16.24	8.32	11.17	12.92	4.70	8.58	12.27	1.74	4.06
Potato fertilizer,	10.77	4.98	1.02	2.59	15.00	6.02	10.45	9.86	5.08	8.07	10.18	2.20	5.67
Tobacco fertilizer,	10.70	5.77	.53	3.33	13.30	5.86	10.05	11.10	1.60	7.34	14.84	2.20	7.38
Root crop fertilizer,	8.14	3.76	3.01	3.31	12.06	9.98	10.64	9.66	7.72	8.59	10.04	7.04	8.05

List of Manufacturers and Dealers who have secured Certificates for the Sale of Commercial Fertilizers in the State during the Past Year (May 1, 1905, to May 1, 1906), and the Brands licensed by Each.

The American Agricultural Chemical Co., Boston, Mass.: —
- High-grade Fertilizer with Ten Per Cent. Potash.
- Grass and Lawn Top Dressing.
- Tobacco Starter and Grower.
- Fine-ground Bone.
- Dissolved Bone-black.
- Muriate of Potash.
- Double Manure Salt.
- High-grade Sulfate of Potash.
- Nitrate of Soda.
- Dry Ground Fish.
- Plain Superphosphate.
- Sulfate of Ammonia.
- Kainit.
- Dried Blood.
- Fine-ground Tankage.
- Ground South Carolina Phosphate.

The American Agricultural Chemical Co. (Bradley Fertilizer Co., branch), Boston, Mass.: —
- Bradley's Complete Manure for Potatoes and Vegetables.
- Bradley's Complete Manure for Corn and Grain.
- Bradley's Complete Manure with Ten Per Cent. Potash.
- Bradley's Complete Manure for Top-dressing Grass and Grain.
- Bradley's X L Superphosphate.
- Bradley's Potato Manure.
- Bradley's Potato Fertilizer.
- Bradley's Corn Phosphate.
- Bradley's Eclipse Phosphate.
- Bradley's Niagara Phosphate.
- Bradley's English Lawn Fertilizer.
- Bradley's Columbia Fish and Potash.
- Bradley's Abattoir Bone Dust.
- Church's Fish and Potash.

The American Agricultural Chemical Co. (H. J. Baker & Bro., branch), New York, N. Y.: —
- Baker's A A Ammoniated Superphosphate.
- Baker's Complete Potato Manure.

The American Agricultural Chemical Co. (Clark's Cove Fertilizer Co., branch), Boston, Mass.: —
- Clark's Cove Bay State Fertilizer.
- Clark's Cove Bay State Fertilizer, G. G.
- Clark's Cove Great Planet Manure.
- Clark's Cove Potato Manure.
- Clark's Cove Potato Fertilizer.
- Clark's Cove King Philip Guano.

The American Agricultural Chemical Co. (Crocker Fertilizer and Chemical Co., branch), Buffalo, N. Y.: —
- Crocker's Potato, Hop and Tobacco Phosphate.
- Crocker's Corn Phosphate.

The American Agricultural Chemical Co. (Cumberland Bone Phosphate Co., branch), Boston, Mass.: —
- Cumberland Superphosphate.
- Cumberland Potato Fertilizer.

The American Agricultural Chemical Co. (L. B. Darling Fertilizer Co., branch), Pawtucket, R. I.: —
- Darling's Blood, Bone and Potash.
- Darling's Complete Ten Per Cent. Manure.
- Darling's Potato Manure.
- Darling's Farm Favorite.
- Darling's Potato and Root Crop Manure.
- Darling's General Favorite.

The American Agricultural Chemical Co. (Great Eastern Fertilizer Co., branch), Rutland, Vt.: —
- Great Eastern Garden Special.
- Great Eastern Vegetable, Vine and Tobacco.
- Great Eastern Northern Corn Special.
- Great Eastern General Fertilizer.
- Great Eastern Grass and Oats Fertilizer.

The American Agricultural Chemical Co. (Pacific Guano Co., branch), Boston, Mass.: —
- Pacific High-grade General.
- Pacific Potato Special.
- Soluble Pacific Guano.
- Pacific Nobsque Guano.

The American Agricultural Chemical Co. (Packers' Union Fertilizer Co., branch), Rutland, Vt.: —
- Packers' Union Universal Fertilizer.
- Packers' Union Potato Manure.
- Packers' Union Animal Corn Fertilizer.
- Packers' Union Gardener's Complete Manure.
- Packers' Union Wheat, Oats and Clover Fertilizer.

The American Agricultural Chemical Co. (Quinnipiac Co., branch), Boston, Mass.: —
- Quinnipiac Market-garden Manure.
- Quinnipiac Phosphate.
- Quinnipiac Potato Manure.
- Quinnipiac Potato Phosphate.
- Quinnipiac Corn Manure.
- Quinnipiac Climax Phosphate.
- Quinnipiac Onion Manure.

The American Agricultural Chemical Co. (Read Fertilizer Co., branch), New York, N. Y.: —
- Read's Practical Potato Special.
- Read's Farmers' Friend.
- Read's Standard.
- Read's High-grade Farmers' Friend.
- Read's Vegetable and Vine.

The American Agricultural Chemical Co. (Standard Fertilizer Co., branch), Boston, Mass.: —
- Standard Complete Manure.
- Standard Fertilizer.
- Standard Special for Potatoes.
- Standard Guano.

The American Agricultural Chemical Co. (Henry F. Tucker Co., branch), Boston, Mass.: —
- Tucker's Original Bay State Bone Superphosphate.
- Tucker's Special Potato Fertilizer.

The American Agricultural Chemical Co. (Williams & Clark Fertilizer Co., branch), Boston, Mass.: —
- Williams & Clark's High-grade Special.
- Williams & Clark's Americus Phosphate.
- Williams & Clark's Potato Phosphate.
- Williams & Clark's Potato Manure.
- Williams & Clark's Corn Phosphate.
- Williams & Clark's Royal Bone Phosphate.
- Williams & Clark's Prolific Crop Producer.

The American Agricultural Chemical Co. (M. E. Wheeler & Co., branch), Rutland, Vt.: —
- Wheeler's Bermuda Onion Grower.
- Wheeler's Potato Manure.
- Wheeler's Havana Tobacco Grower.
- Wheeler's Corn Fertilizer.
- Wheeler's Grass and Oats Fertilizer.

W. H. Abbott, Holyoke, Mass.: —
- Abbott's Animal Fertilizer.
- Abbott's Eagle Brand.
- Abbott's Tobacco Fertilizer.

The American Cotton Oil Co., New York, N. Y.: —
- Cotton-seed Meal.
- Cotton-seed Hull Ashes.

The American Linseed Co., New York, N. Y.: —
- Cleveland Flax Meal.

Armour Fertilizer Works, Baltimore, Md.: —
- Armour's Grain Grower.
- Armour's Blood, Bone and Potash.
- Armour's High-grade Potato.
- Armour's All Soluble.
- Armour's Ammoniated Bone with Potash.
- Armour's Bone Meal.
- Armour's Complete Potato.
- Armour's Corn King.
- Armour's Market-garden Fertilizer.

H. J. Baker & Bro., New York, N. Y.: —
- Castor Pomace.

Beach Soap Co., Lawrence, Mass.: —
- Beach's Advance Fertilizer.
- Beach's Reliance Fertilizer.

Berkshire Fertilizer Co., Bridgeport, Conn.: —
- Complete Fertilizer.
- Potato and Vegetable Phosphate.
- Ammoniated Bone Phosphate.

Joseph Breck & Sons, Boston, Mass.: —
- Breck's Lawn and Garden Dressing.
- Breck's Market-garden Manure.

Bowker Fertilizer Co., Boston, Mass.: —
- Stockbridge Special Manures.
- Bowker's Hill and Drill Phosphate.
- Bowker's Farm and Garden Phosphate.
- Bowker's Lawn and Garden Dressing.
- Bowker's Potato and Vegetable Fertilizer.
- Bowker's Fish and Potash (Square Brand).
- Bowker's Potato and Vegetable Phosphate.
- Bowker's Sure Crop Phosphate.
- Gloucester Fish and Potash.
- Bowker's High-grade Fertilizer.
- Bowker's Bone and Wood Ash Fertilizer.
- Bowker's Fish and Potash ("D" Brand).
- Bowker's Corn Phosphate.
- Bowker's Blood, Bone and Potash.
- Bowker's Early Potato Manure.
- Bowker's Bristol Fish and Potash.
- Bowker's Fine-ground Dry Fish.

Bowker Fertilizer Co., Boston, Mass. — *Con.*
- Bowker's Tobacco Ash Elements.
- Bowker's Wood Ashes.
- Bowker's Ground Bone.
- Bowker's Superphosphate.
- Sulfate of Ammonia.
- Nitrate of Soda.
- Dissolved Bone-black.
- Muriate of Potash.
- Sulfate of Potash.
- Dried Blood.
- Bowker's Soluble Animal Fertilizer.
- Bowker's Tobacco Starter.
- Bowker's Tobacco Ash Fertilizer.
- Bowker's Market-garden Fertilizer.
- Bowker's Potash Bone.
- Bowker's Ten Per Cent. Manure.
- Kainit.
- Bowker's Complete Mixture.
- Bowker's Ammoniated Food for Flowers.
- Double Manure Salt.
- Bowker's Tankage.
- Bowker's Clover Brand Bone and Wood Ash.
- Bowker's Flour of Bone.
- Bowker's Market Bone.
- Bowker's Ground Phosphate Rock.
- Bowker's Ammoniated Dissolved Bone.
- Bowker's Square Brand Bone and Potash.
- Bowker's Potash or Staple Phosphate.
- Bowker's Special Fertilizer for Seeding Down.

F. W. Brode & Co., Memphis, Tenn.: —
- Owl Brand Pure Cotton seed Meal.

T. H. Bunch, Little Rock, Ark.: —
- Cotton-seed Meal.

Charles M. Cox & Co., Boston, Mass.: —
- Cotton-seed Meal.

Chicopee Rendering Co., Springfield, Mass.: —
- Lawn and Garden Dressing
- Vegetable and Potato Fertilizer.

E. Frank Coe Co., New York, N. Y.: —
- E. Frank Coe's High-grade Ammoniated Bone Superphosphate.
- E. Frank Coe's Gold Brand Excelsior Guano.
- E. Frank Coe's Excelsior Potato Fertilizer.
- E. Frank Coe's Tobacco and Onion Fertilizer.
- E. Frank Coe's Columbian Corn Fertilizer.

E. Frank Coe Co., New York, N. Y. — *Con.*
- E. Frank Coe's Columbian Potato Fertilizer.
- E. Frank Coe's New Englander Potato Fertilizer.
- E. Frank Coe's New Englander Corn Fertilizer.
- E. Frank Coe's X X X Pure Ground Bone.
- E. Frank Coe's F. P. Fish and Potash.
- E. Frank Coe's Red Brand Excelsior Guano.
- E. Frank Coe's Celebrated Special Potato.
- E. Frank Coe's Grass and Grain Special.
- E. Frank Coe's X X X Ammoniated Bone Phosphate.
- E. Frank Coe's Muriate of Potash.
- E. Frank Coe's Nitrate of Soda.

John C. Dow & Co., Boston, Mass.: —
- Dow's Pure Ground Bone.

The Eureka Liquid Fertilizer Co., Boston, Mass.: —
- Eureka Liquid Fertilizer.

William E. Fyfe & Co., Clinton, Mass.: —
- Hard Wood Canada Ashes.

R. & J. Farquhar & Co., Boston, Mass.: —
- Clay's London Fertilizer.

C. W. Hastings, Ashmont, Mass.: —
- Ferti Flora.

Thomas Hersom & Co., New Bedford, Mass.: —
- Bone Meal.
- Meat and Bone.

Hunter Brothers Milling Co., St. Louis, Mo.: —
- Prime Cotton-seed Meal.

John Joynt, Lucknow, Ont., Can.: —
- Joynt Brand Hard-wood Ashes.

A. Klipstein & Co., New York, N. Y.: —
- Carbonate of Potash.

Lister's Agricultural Chemical Works, Newark, N. J.: —
- Lister's Success Fertilizer.
- Lister's Special Corn Fertilizer.
- Lister's Special Potato Fertilizer.
- Lister's Potato Manure.
- Lister's High-grade Special for Spring Crops.
- Lister's Oneida Special.
- Lister's Animal Bone and Potash.

Swift's Lowell Fertilizer Co., Boston, Mass.: —
- Swift's Lowell Bone Fertilizer.
- Swift's Lowell Potato Phosphate.
- Swift's Lowell Dissolved Bone and Potash.
- Swift's Lowell Animal Brand.
- Swift's Lowell Market-garden Manure.
- Swift's Lowell Potato Manure.
- Swift's Lowell Empress Brand.
- Swift's Lowell Superior Fertilizer.
- Swift's Lowell Special Grass Mixture.
- Swift's Lowell Lawn Dressing.
- Swift's Lowell Perfect Tobacco Grower.
- Swift's Lowell Ground Bone.
- Swift's Lowell Special Vegetable Manure.
- Acid Phosphate.
- Nitrate of Soda.
- Muriate of Potash.
- Tankage.

George E. Marsh & Co., Lynn, Mass.: —
- Pure Bone Meal.

D. M. Moulton, Monson, Mass.: —
- Ground Bone.

Mapes Formula and Peruvian Guano Co., New York, N. Y.: —
- Mapes' Potato Manure.
- Mapes' Tobacco Starter Improved.
- Mapes' Tobacco Manure (Wrapper Brand).
- Mapes' Economical Potato Manure.
- Mapes' Average Soil Complete Manure.
- Mapes' Vegetable Manure or Complete Manure for Light Soils.
- Mapes' Corn Manure.
- Mapes' Complete Manure ("A" Brand).
- Mapes' Cereal Brand.
- Mapes' Complete Manure Ten Per Cent. Potash.
- Mapes' Top-dresser Improved, Half Strength.
- Mapes' Tobacco Ash Constituents.
- Mapes' Grass and Grain Spring Top-dressing.
- Mapes' Fruit and Vine Manure.
- Mapes' Cauliflower and Cabbage Manure.

National Fertilizer Co., Bridgeport, Conn.: —
- Chittenden's Complete Fertilizer.
- Chittenden's High-grade Special Tobacco.
- Chittenden's Market Garden.
- Chittenden's Potato Phosphate.

National Fertilizer Co., Bridgeport, Conn. — *Con.*
- Chittenden's Ammoniated Bone.
- Chittenden's Fish and Potash.
- Chittenden's X X X Fish and Potash.
- Chittenden's Formula "A."

New England Fertilizer Co., Boston, Mass.: —
- New England Corn Phosphate.
- New England Potato Fertilizer.
- New England Superphosphate.
- New England High-grade Potato Fertilizer.

Olds & Whipple, Hartford, Conn.: —
- Complete Tobacco Fertilizer.
- Vegetable Potash.

R. T. Prentiss, Holyoke, Mass.: —
- Prentiss Complete Fertilizers.

Parmenter & Polsey Fertilizer Co., Peabody, Mass.: —
- Plymouth Rock Brand.
- Special Fertilizer for Strawberries.
- Special Potato Fertilizer.
- Nitrate of Soda.
- A. A. Brand Fertilizer.
- P. & P. Potato Fertilizer.
- Pure Ground Bone.
- Lawn Dressing.
- P. & P. Grain Grower.
- Star Brand Superphosphate.

Rogers & Hubbard Co., Middletown, Conn.: —
- Hubbard's Oats and Top-dressing.
- Hubbard's Grass and Grain.
- Hubbard's Soluble Corn.
- Hubbard's Soluble Potato.
- Hubbard's Soluble Tobacco.
- Hubbard's All Soils and All Crops.
- Hubbard's Corn Phosphate.
- Hubbard's Potato Phosphate.
- Hubbard's Market-garden Phosphate.
- Hubbard's Raw Knuckle Bone Flour.
- Hubbard's Strictly Pure Fine Bone.

Rogers Manufacturing Co., Rockfall, Conn.: —
- All Round Fertilizer.
- Complete Potato and Vegetable Fertilizer.
- High-grade Complete Corn and Onion.
- Fish and Potash.
- High-grade Tobacco and Potato.
- High-grade Oats and Top-dressing.
- High-grade Grass and Grain.
- High-grade Soluble Tobacco.
- Pure Knuckle Bone.

Ross Bros., Worcester, Mass.: —
- Ross Brothers' Lawn Dressing.

N. Roy & Son, South Attleborough, Mass.: —
Complete Animal Fertilizer.

Russia Cement Co., Gloucester, Mass.: —
Essex Dry Ground Fish.
Essex Complete Manure for Potatoes, Roots and Vegetables.
Essex Complete Manure for Corn, Grain and Grass.
Essex Market-garden and Potato Manure
Essex Corn Fertilizer.
Essex A I Superphosphate.
Essex X X X Fish and Potash.
Essex Odorless Lawn Dressing.
Essex Tobacco Starter.
Essex Special Tobacco Manure.
Essex Rhode Island Special.
Essex Grass and Top-dressing.
Essex Nitrate of Soda.

Sanderson's Fertilizer and Chemical Co., New Haven, Conn.: —
Sanderson's Formula "A".
Sanderson's Formula "B".
Sanderson's Potato Manure.
Sanderson's Corn Superphosphate.
Sanderson's Fine-ground Fish.
Sanderson's Sulfate of Potash.
Walker's Complete Phosphate.
Walker's Complete Fertilizer.
Walker's High-grade Fertilizer.
Niantic Bone, Fish and Potash.
Old Reliable Superphosphate.

The Smith Agricultural Chemical Co., Columbus, O. (Abbott & Martin Rendering Co., branch): —
Harvest King.
Tobacco and Potato Special.

The Smith Agricultural Chemical Co., Columbus, O. (Hardy Packing Co., branch): —
Tankage Bone and Potash.
Tobacco and Potato Special.

M. L. Shoemaker & Co., Limited, Philadelphia, Pa.: —
Swift Sure Superphosphate.
Swift Sure Bone Meal.

Thomas L. Stetson, Randolph, Mass.: —
Bone Meal.

A. L. Warren, Northborough, Mass.: —
Warren's Ground Bone.

The Whitman & Pratt Rendering Co., Lowell, Mass.: —
Whitman & Pratt's All Crops.
Whitman & Pratt's Corn Success.
Whitman & Pratt's Vegetable Grower.
Whitman & Pratt's Potash Special.
Whitman & Pratt's Pure Ground Bone.
Whitman & Pratt's Potato Plowman.

Wilcox Fertilizer Works, Mystic, Conn.: —
Wilcox Potato, Onion and Tobacco Manure.
Wilcox Potato Fertilizer.
Wilcox Complete Bone Superphosphate.
Wilcox Fish and Potash.
Wilcox High-grade Tobacco Special.
Wilcox Dry Ground Fish.

Sanford Winter, Brockton, Mass.: —
Pure Fine-ground Bone.

J. M. Woodward & Bro., Greenfield, Mass.: —
Tankage.

PART II. — REPORT ON GENERAL WORK IN THE CHEMICAL LABORATORY.

C. A. GOESSMANN.

1. Analyses of materials forwarded for examination.
2. Notes on wood ashes and lime ashes.

1. ANALYSES OF MATERIALS FORWARDED FOR EXAMINATION.

We have received 257 samples of miscellaneous substances, during the season, from farmers within our State. As far as circumstances and time permit we have taken up these materials for analysis, and as a general thing have reported results in the order of their arrival at this office. As in the past, we have been obliged to neglect this class of work until a lull occurred in the official inspection of commercial fertilizers. From December to April we have most time to devote to the investigation of general material, and for this reason would prefer to have the samples forwarded whenever possible, so they may be taken up during these months. This would insure more prompt reports of the results of analyses.

We have taken the usual active part in the technical chemical work of the Association of Official Agricultural Chemists for the establishment of new methods of chemical analysis, more particularly in regard to fertilizer work and the analysis of insecticides. We have also been in co-operation with the American Chemical Society and the United States Geological Survey in regard to technical details in the chemical analysis of argillaceous limestone. The results of these analyses were sent to the respective parties in Washington.

Following is a list of materials forwarded by farmers during the year: —

Soils,	54	Factory waste,	2
Wood ashes,	47	Ashes from leather scraps,	2
Complete fertilizers,	32	Insecticides,	2
Cotton-seed meal,	24	Oyster shells,	1
Lime ashes,	8	Sulfate of ammonia,	1
Miscellaneous materials,	7	Blood,	1
Nitrate of soda,	6	Wool waste ashes,	1
Manure,	6	Chicken grit,	1
Muck,	5	Tobacco dust,	1
Tankage,	4	Argillaceous limestone,	1
Superphosphate,	4	Burned bone,	1
Cotton-hull ashes,	4	Low-grade sulfate of potash,	1
High-grade sulfate of potash,	3	River mud,	1
Ground bone,	3	Cob ashes,	1
Bone and meat,	3	Castor pomace,	1
Sheep manure,	3	Linseed meal,	1
Peruvian guano,	3	Mud from seaweed,	1
Peat,	3	Cotton-seed compost,	1
Dry ground fish,	2	Damaged cocoa,	1
Dissolved bone-black,	2	Prepared bone,	1
Wood charcoal,	2	Vegetable potash,	1
Muriate of potash,	2	Rotten cotton waste,	1
Carbonate of potash,	2		

2. Notes on Wood Ashes and Lime Ashes.

(a) *Wood Ashes.*

Eighteen and one-half per cent. of the materials forwarded by farmers during the year have been wood ashes. The following table shows their chemical composition as compared with the previous year: —

Analysis of Wood Ashes.

	Number of Samples.	
	1904.	1905.
Moisture from 1 to 10 per cent.,	18	15
Moisture from 10 to 20 per cent.,	16	20
Moisture from 20 to 30 per cent.,	8	7
Moisture above 30 per cent.,	3	1
Potassium oxide above 8 per cent.,	2	4
Potassium oxide from 6 to 7 per cent.,	8	4
Potassium oxide from 5 to 6 per cent.,	6	12
Potassium oxide from 4 to 5 per cent.,	12	13
Potassium oxide from 3 to 4 per cent.,	10	7
Potassium oxide below 3 per cent.,	7	3
Phosphoric acid above 2 per cent.,	3	7
Phosphoric acid from 1 to 2 per cent.,	30	32
Phosphoric acid below 1 per cent.,	12	4
Average per cent. of calcium oxide (lime),	30.16	32.30
Insoluble matter below 10 per cent.,	6	9
Insoluble matter from 10 to 15 per cent.,	18	14
Insoluble matter above 15 per cent ,	20	20

Table showing the Maximum, Minimum and Average Per Cents. of the Different Ingredients found in Wood Ashes, 1904 and 1905.

	Maximum.		Minimum.		Average.	
	1904.	1905.	1904.	1905.	1904.	1905.
Moisture at 100° C.,	37.85	32.05	none.	.02	14.42	13.45
Potassium oxide,	11.04	8.68	.80	2.32	4.51	5.09
Phosphoric acid,	6.07	4.74	.28	.38	1.37	1.67
Calcium oxide,	42.86	49.24	19.73	21.17	30.16	32.30
Insoluble matter,	47.21	33.32	4.56	4.15	18.35	15.49

From the above comparison it will be seen that the ashes analyzed during the year are of much better quality than for the year 1904. We wish to urge parties who buy wood ashes to patronize those importers and dealers who have secured a license for the sale of ashes in Massachusetts, for

it is only in this way that they can secure protection by our State laws. Wood ashes should always be bought on a statement of guarantee of potash, phosphoric acid and lime.

(*b*) *Lime Ashes.*

Table showing the Maximum, Minimum and Average Per Cents. of the Different Ingredients found in Lime Ashes, 1904 and 1905.

	Maximum.		Minimum.		Average.	
	1904.	**1905.**	**1904.**	**1905.**	**1904.**	**1905.**
Moisture,	36.62	19.35	none.	.05	10.88	11.18
Potassium oxide,	2.46	4.80	.06	1.02	1.54	2.47
Phosphoric acid,	1.48	1.58	trace.	.18	.74	.97
Calcium oxide,	55.24	63.44	21.92	37.56	42.93	49.34
Insoluble matter,	25.47	28.93	2.76	3.21	8.11	8.99

It will be seen from the above comparison that the average composition of lime ashes for the past year is superior to that of 1904. The only safe way to buy lime ashes is to insist upon a guarantee of potash, phosphoric acid and lime which they are said to contain.

REPORT OF THE CHEMIST.

DIVISION OF FOODS AND FEEDING.[1]

J. B. LINDSEY.

Chemical Assistants: E. B. HOLLAND, P. H. SMITH, E. S. FULTON,[2] A. C. WHITTIER.
Inspector of Feeds and Babcock Machines: A. PARSONS,[3] F. G. HELYAR.
Dairy Tester: S. R. PARKER.
In Charge of Feeding Experiments: J. G. COOK,[4] R. F. GASKILL.
Stenographer: MABEL C. SMITH.

PART I. — THE WORK OF THE YEAR.

1. Correspondence.
2. Summary of laboratory work.
3. Water analysis.
4. Dairy products and cattle feeds.
5. Special chemical work.
6. Feed control.
7. Act for protection of dairymen.
8. The testing of pure-bred cows.
9. Work completed.
10. Work in progress.
11. Changes in staff.

PART II. — EXPERIMENTS IN ANIMAL NUTRITION.

1. Bibby's dairy cake.
2. Eureka silage corn.
3. Concerning wheat bran.

[1] See also tables in Appendix.
[2] Resigned Sept. 15, 1905.
[3] Resigned July 1, 1905.
[4] Resigned Aug. 1, 1905.

Part I. — The Work of the Year.

J. B. LINDSEY.

1. Correspondence.

The answering of inquiries relative to feeding and dairy problems has continued to be a feature of the correspondence of this department. Grain dealers appear desirous of being well posted on the various feed stuffs in the market, and are constantly writing for information. The total number of letters of all kinds sent out during the year was approximately 3,600.

2. Summary of Laboratory Work.

The usual variety of chemical work has been carried out during the year.

There have been sent in for examination 102 samples of water, 792 of milk, 1,717 of cream, 5 of butter, 191 of feed stuffs and 6 miscellaneous. In connection with experiments by this and other divisions of the station, there have been analyzed, in whole or in part, 236 samples of milk and cream and 142 of fodders and feed stuffs. This makes a total of 4,042 substances analyzed during the year, as against 4,261 last year and 3,897 in the previous year. Work on the determination of sulphur in organic bodies, and nitrogen compounds in cheese, not included in the above, has been done for the Association of Official Agricultural Chemists. In addition, 13 candidates have been examined and given certificates to operate Babcock machines, and 1,665 pieces of glassware have been tested for accuracy, of which 197 pieces, or 11.83 per cent., were condemned.

3. Water Analysis.

The experiment station has made a feature of sanitary water analysis since its establishment in 1882. Within a few years a charge of $3 a sample has been placed upon this

work, in order to hold in check many who have seemingly abused the privilege of free analysis. Instructions for securing an analysis are issued in circular form, as follows: —

Those wishing to secure a sanitary analysis of water must first make application, whereupon a glass bottle securely encased, accompanied by full instructions for collecting and shipping the sample, will be forwarded by express. The return express must in all cases be prepaid. Because of the smallness of the sum involved, no account will be opened. Remittance by check, P. O. money order, or money at the owner's risk, must be strictly in advance.

Address Dr. J. B. Lindsey,

Hatch Experiment Station, Amherst, Mass.

The results of the analysis are forwarded on especially prepared blanks, with such additional remarks concerning the condition of the water, and its possible improvement, as is warranted in each case. This station does not make mineral analysis of water, excepting at rare intervals by special arrangement.

4. Dairy Products and Cattle Feeds.

This department makes free analyses of milk, cream and cattle feeds for farmers and others, in so far as its resources permit. About the usual number have been received during the year. Many farmers and dairymen desire to know the percentage of fat and total solids in the milk produced by their herd and by individual animals, and send samples to the station for analysis. They are thus enabled to determine the quality of the product placed upon the market, and also the value of the cow for profitable milk production. The quality of the milk shipped to Boston is carefully scrutinized by the several contractors, and producers frequently send samples to the station, to ascertain whether their product is conforming to the legal requirements. Parties who have been warned by the contractors, or have had their milk refused, likewise forward samples, with requests for information as to methods of betterment. The station tries to be as helpful as possible in all such cases. One creamery sends

its samples regularly, and others send occasional lots, when not in condition to satisfactorily perform the work, or when desiring to check their own results. A charge is made in such cases sufficient to cover the cost of the work.

Farmers and grain dealers are constantly sending samples of feeds for examination, to determine their value and whether they are as represented. This work takes considerable time, but it is worthy of encouragement. It must not be understood, however, that the station furnishes a free chemical laboratory for jobbers and manufacturers who wish to ascertain the composition of their feeds for commercial purposes. The station does not solicit work of this character, but is willing to undertake a limited amount for a reasonable compensation.

5. Special Chemical Work.

During the year the department has undertaken co-operative work on chemical methods in connection with the Association of Official Agricultural Chemists, and has studied particularly methods for the determination of sulphur in organic substances, and of nitrogenous compounds in cheese. The department has also co-operated with the department of botany in ascertaining the amount of starch and sugars in cucumber leaves, grown under definite conditions.

6. Feed Control (Acts of 1903, Chapter 202).

The several provisions of this act have been executed as heretofore. Bulletin No. 101, containing the analyses of 306 samples of feeds collected the previous autumn, was distributed early in January of 1905. This bulletin also contained many remarks and suggestions on the nutritive and commercial values of concentrates. Bulletin No. 106, sent out in October, 1905, gave the chemical and microscopic analyses of 65 samples of condimental stock and poultry foods, and the results of an experiment with Pratt's food. During the months of January, February, March and April, the inspector twice visited the most important cities and towns in the State, and collected 481 samples of feeds. The entire collection was tested during the late spring and early

summer. For financial reasons, it was not possible to publish the results in bulletin form. Those that were considered at all suspicious were examined by both the chemist and the microscopist, and the attention of retail dealers, jobbers and manufacturers called to any irregularities. Brief notes regarding this collection were published in Bulletin No. 106. The inspector canvassed the entire State in September and October, and the 365 samples collected are now being examined, and the results will be ready for publication in December.

The large majority of manufacturers, jobbers and retailers willingly conform to the requirements of the law. Considerable difficulty is frequently experienced in obtaining a statement in full, many omitting the weight of the package, and a few stating the protein and fat guarantees together. Some manufacturers and jobbers have been lax in attaching any guarantee whatever, and retailers have frequently offered unguaranteed goods for sale. The station has endeavored to be very patient with offenders, giving them full opportunity to conform to the statute requirements. The writer recognizes the diversity of conditions governing the purchase and sale of the great variety of concentrated feeds, and has been willing to condone many technical violations of the law, when it appeared that no intentional offence was intended. Some parties seem inclined to take advantage of this seeming leniency, and such it may be necessary to call to a sharp account.

The value of an intelligent and tactful inspector cannot be too strongly emphasized. He is in position to impart much valuable information to the dealer, and to smooth out many difficulties that may arise. The station finds it difficult to retain the services of a satisfactory person for any length of time, because of the small salary paid.

The great bulk of feed now offered is free from intentional adulteration, and is as represented. Buyers, as a rule, have only themselves to blame if they are defrauded. Much cotton-seed meal is being guaranteed several per cent. lower in protein than formerly, manufacturers claiming that it does not pay them to completely remove the hulls. It is

also stated that this lower-grade meal is shipped from other territory than that formerly supplying the Massachusetts markets.

Gluten feed and wheat by-products tested low in protein during 1905, owing to the inferior character of the 1904 corn and wheat.

Porto Rico molasses and a considerable variety of molasses feeds are being freely offered. The station is making a special study of these products, and hopes to publish the results in bulletin form within the next few months.

Rice by-products in considerable quantity are being sold in the southwest, but as yet they have not been offered in local markets. Detailed information concerning the composition and value of concentrates may be obtained by consulting the special bulletins on the subject.

7. An Act for the Protection of Dairymen (Acts of 1901, Chapter 202).

This act makes it obligatory for all creameries and milk depots within the State, employing the Babcock test or any other test for determining the value of milk or cream, to have all graduated glassware used in making such determinations tested for accuracy by this station. It further requires that all parties intending to operate such machines must first be examined for competency by the proper official of the station. Once each year the station is obliged to send a competent party to each creamery and milk depot within the State where such machines are in use, to duly inspect said machines and pronounce upon their fitness for the work. This department has endeavored to carry out the several provisions of this law with the same care as formerly. The following is a brief report of the work for 1905: —

Inspection of Glassware. — All glassware found to be correctly graduated has been marked "Mass Ex St." There were 1,665 pieces examined, of which 197, or 11.83 per cent., were condemned. The inaccurate bottles were largely of the bulb type (Bartlett). Until last year these bottles have been passed on accuracy of total graduation, as the usual charge of 5 cents a piece would not permit of additional

testing. Because of the difficulty in securing a correct graduation, it has been necessary to test the three distinct portions of the scale at a corresponding increase in cost. The use of this type of bottle is not to be encouraged.

Examination of Candidates. — A few less candidates than usual were examined, and 13 certificates of competency issued. Many candidates showed poor manipulation, and lacked a thorough understanding of the method. In case of failure, applicants are obliged to wait a month before a second examination will be given.

Inspection of Babcock Machines. — The inspection of machines the present year has been in charge of Mr. Frank G. Helyar, who makes the following report: —

The annual inspection of Babcock machines was made in November and December. Fifty-two places were either visited or heard from, of which number only 36 were amenable to the inspection. Those creameries or milk depots that did not come under the inspection were exempt for two reasons: some of them do not possess a machine, but have their samples regularly tested by city inspectors; while others have machines, but from all that can be learned they neither buy nor sell milk or cream on the results of their own tests. In suspicious cases they carry samples to the city inspector. There are three creameries paying by the space and one by the churn test.

Of the total number, 34 were creameries and 18 were milk depots. Of the 34 creameries, 19 were situated west of the Connecticut River, and, as a rule, in the back-hill towns, away from good transportation facilities. The rest of the creameries were scattered throughout the eastern part of the State. The milk depots, on the other hand, are situated nearer the large cities. Twenty of the milk depots and creameries were co-operative, while the rest were either proprietary or stock companies. The number of co-operative creameries is steadily decreasing.

As a whole, the machines were found to be in very good condition, none being condemned, and only 3 needing repairs. The cast-iron machine is being used in every place visited but 4. The Facile is used in 19 places, the Agos in 9 and the Wizard in 3.

Most of the owners of the Babcock machines have recognized

the value of a substantial foundation as a factor in keeping their machines in good repair. Still, there are a few machines that are being used on rather insecure and shaky supports. As a result, these machines are always a little out of level, and run with more or less unnecessary vibration. Some machines, even with repairs suggested in previous inspections, still overheat the samples. The operators of these machines counteract this by allowing the machine to run a few moments at the end of the test with the cover lifted. No machine was found that insufficiently heated the samples. The steam gauges, with only one or two exceptions, were found to be in good order. In those cases where they were not in good order, speed indicators are used to check up the speed of the machines.

Only in one place was untested glassware found. In some cases it was not as clean as it ought to be, but, on the whole, may be said to be in very good condition.

In addition to the regular work of the inspection, 4 city milk inspectors were visited. Only 1 desired an examination. His machine, an electrical Wizard, was given a certificate.

The above law is not as comprehensive as one could wish. It makes no financial provision for the purpose of carrying out the provisions of section 3 (inspection of machines), but requires the director of the station, or his agent, to make the inspection, and to assess the cost upon the several creameries inspected. The station is obliged to advance the expense out of its treasury, and collect 35 or 40 small bills resulting. Most creameries pay with a reasonable degree of promptness, but a few parties are obstinate and slow.

After the station has issued a certificate of competency to the operator of a Babcock machine, it has no further control over said party, even though he may prove careless, and even dishonest in his future operations. The law could be improved, and thus give a fuller measure of protection to dairymen, by a small annual State appropriation, together with the necessary authority to make a semi-annual inspection of all Babcock or similar machines, and of all glassware used in connection therewith, and by empowering the director of the experiment station, or some other competent party, to rescind the license of all operators who do not appear to be satisfactorily performing their duties.

8. The Testing of Pure-bred Cows.

Breeders of pure-bred Jersey, Guernsey and Holstein cattle are making tests of the weekly and yearly yields of milk and butter fat produced by their cows, under the rules and regulations of the several national cattle clubs. The rules require that these tests be made under the strict supervision of an officer of the Agricultural College or Experiment Station. This department has undertaken the work for Massachusetts breeders. Considerable more testing has been required during 1905 than heretofore, necessitating the temporary employment of 5 different inspectors at one time. It is frequently quite difficult and time-consuming for the regular employees to be required to meet the sudden demands of breeders for men to do work of this character, although thus far all calls for men and apparatus have been met promptly. Breeders ought to give the station at least ten days' notice. The cost of this work is paid by the parties for whom it is done, and includes tester's time at $2 to $2.50 a day, board, travelling expenses and breakage. There are at present 44 Jerseys and 29 Guernseys under yearly tests, belonging to F. L. Ames, North Easton, N. I. Bowditch, Framingham, W. L. Cutting, Pittsfield, C. H. Jones, Wellesley Farms, A. H. Sagendorph, Spencer, Storrs Agricultural College, Storrs, Conn., C. I. Hood, Lowell, A. F. Pierce, Winchester, N. H., and R. A. Sibley, Spencer. Eight seven-day milk and butter fat tests have been made for the Jersey Cattle Club, and 37 for the Holstein-Friesian Association, and the yearly tests of 32 Jerseys and 12 Guernseys have been completed.

9. Work completed.

Eureka Silage Corn. — A two-years experiment, to study the composition, digestibility and economic value of this corn, a coarse southern dent, as compared with a medium dent that will mature its seed in our latitude, has been completed, and the details and conclusions reported in Part II. of the present report.

The Value of Wheat Bran. — The results of a study of the

cost of digestible protein and total digestible matter in wheat bran, as well as the use of bran in the farm economy, are presented quite fully in Part II.

Bibby's Dairy Cake. — Digestion tests and an experiment with dairy cows have been completed with this feed. The details of the experiment, and the conclusions, will be found as a portion of Part II.

Market Milk, its Production and Composition. — This department has investigated the conditions governing the production of milk in the territory supplying Amherst and Northampton, as well as the chemical and bacteriological composition of the milk. It is believed that the methods of production and the quality of the product are much the same as in other sections of the State. In general, it may be said that: —

1. The sanitary conditions on the whole were unsatisfactory.

2. The majority of producers were not familiar with, or did not apply, the teachings of modern dairy principles.

3. The chemical composition of most of the milk was above the Massachusetts standard.

4. A great deal of the milk contains an excess of bacteria, and indicated unsanitary methods of handling.

5. The milk was practically all retailed at 6 cents a quart, — a price too low to enable the producer to profitably produce an article under satisfactory sanitary conditions.

It is believed that producers supplying milk for human consumption should be subject to a system of regular, competent inspection, and that no one should receive a license who does not conform to reasonable sanitary conditions. The public needs to be educated relative to the great food value of milk, and ought to be willing to pay a fair price for an approved article. It is hoped to soon publish the detailed results of this investigation in bulletin form.

Digestion Experiments with Sheep. — There have been completed digestion experiments with soy bean fodder, Eureka corn fodder and Eureka corn stover, Pride of the North corn stover, Blomo feed for horses, malt sprouts, Sucrene, Holstein and Macon sugar feeds, hominy feed,

buckwheat and oat middlings. The results have been incorporated in the tables of digestion coefficients, in the Appendix. The details of these experiments and a discussion of the results are reserved for a future publication.

Sorghum and Other Forage Crops. — Trials of a variety of green crops for summer soiling are conducted each year. Sorghum has been given particular attention for the last two years. A very complete analysis of this crop has been made at different stages of growth, and, likewise, digestion trials with sheep, the results of which are not as yet completed. The seed [1] was sown broadcast at the rate of 1 bushel per acre, the 25th of May. Cutting was begun as soon as the heads appeared (about August 10), and the yield was at the rate of 19 tons to the acre. The animals ate it well, and it should prove a satisfactory addition to the list of green feeds. A more detailed statement concerning the quality and value of this crop for soiling will be given in a future publication.

The station has found the following crops quite satisfactory for soiling purposes: peas and oats, the first seeding to be made April 25 and each ten days thereafter, ready to cut from June 25 to July 20; barnyard millet, first seeding to be made May 25 and another seeding two weeks later, ready for feeding from July 20 to August 10; sorghum to be seeded May 25, ready to cut August 10 to 30; Stowell's Evergreen sweet corn, or Longfellow field corn, seeded May 15 to 20, will serve admirably for September green fodder, and later if frosts are not severe.

Soy beans may be sown with the corn, but it is believed that, on the whole, more satisfactory results can be obtained by cultivating each crop separately. It is hoped to publish a bulletin on the subject of soiling in the near future. Copies of a former bulletin on this subject (No. 72) are not available.

Useful Legumes. — A study has been made of the composition, digestibility and yields of the more prominent leguminous crops, with a view to determine their practical adaptability to New England conditions, and it is desired

[1] Seed purchased of Wm. Henry Maule, Philadelphia, Pa., at $2.25 a bushel.

to publish a concise description of this work in the near future.

Clover is unquestionably the most valuable legume, serving admirably as a soil renovator, cover crop, soiling crop, and as a component of the hay crop. Canada peas are valuable chiefly for soiling purposes, and in some cases as a cover crop. Sand vetch (*Vicia sativa*) makes a good legume to be sown in the autumn with wheat for early summer soiling. It also serves as a soil renovator and as a cover crop. Shammel, in Bulletin No. 149 of the Connecticut Experiment Station, has called attention to the value of this plant when sown after the removal of tobacco. It blossoms about June 1, and can then be plowed under, adding materially to the humus and nitrogen content of the soil. It seeds poorly, and the seed is very expensive, which will naturally much restrict its use. Alfalfa has been tried repeatedly on the station ground under favorable conditions, but it has not as yet proved a satisfactory crop for practical purposes. It is affected with "leaf-spot," winter-kills, and is crowded out by clover and grasses. Occasionally one hears of successes by Massachusetts farmers. It is suggested that our farmers try it in a small way (¼ acre), and see if it will thrive in their locality. Soy beans (Brooks's medium green) and several varieties of cow peas have been carefully studied; the latter are best suited to a more southern climate. The soy beans thrive well in Massachusetts, and may be used with satisfaction as a soiling crop, and mixed with corn for silage purposes. It is believed, however, that it will prove more economical, as a rule, for farmers and dairymen possessing satisfactory markets and railroad facilities to purchase their protein in the form of high-grade concentrates, rather than attempt to grow it in the form of soy bean forage or seed. Soy beans may prove an economical crop for localities situated at some distance from markets and railroads.

Compilation of Analyses. — Attention is called to the tables of composition and digestion of American feed stuffs, recently compiled, and published in the Appendix to this report.

10. Work in Progress.

Molasses and Molasses Feeds. — Work is in progress to determine the digestibility and comparative value and place in the farm economy of Porto Rico molasses and molasses feeds. Feeds of this character are being freely advertised and sold in our local markets. It is hoped to bring this work to a close early in the new year, and to report the results in bulletin form within a short time thereafter.

Nitro-cultures for Legumes. — The United States Department of Agriculture has called attention to the value of the cultures produced by its expert, Dr. Moore, for the different leguminous crops. Hellriegel of Germany was the first to scientifically demonstrate the symbiotic action of bacteria with the legumes, resulting in the fixation of atmospheric nitrogen. This subject has been given a great deal of study by many other scientists, particularly by Nobbe and his co-workers, who have isolated and prepared cultures suited to the different varieties of legumes. Moore claims that he has succeeded in isolating and developing varieties of bacteria that are especially active as nitrogen gatherers. This department has secured the Moore cultures for two years, and used them upon alfalfa, soy beans and cow peas. The directions were carefully followed in all cases, but no particular results were obtained that could be attributed directly to the action of the applied cultures. The yields for the soy bean and cow pea plots receiving the cultures were no greater than those not receiving them, neither did the plots thus treated show any noticeable increased nodular development. A newly seeded piece of alfalfa, inoculated with soil from an old alfalfa field, seemed to receive a decided help from the treatment, judging from the growth and apparent vigor of the plants. The writer would in no way condemn the Moore cultures, knowing the progress that has been achieved by numerous investigators along this line. Farmers may try the Moore cultures in a small way, but should not be disappointed if the results are not as expected. The daily press and popular journals have made altogether too extravagant

statements and claims regarding them. Work of this character still requires much study before the highest practical results are secured.

11. Changes in Staff.

Albert Parsons, B.S., for two years employed as inspector of concentrated feeds and of Babcock machines, resigned July 1, to accept a position as assistant superintendent at Hood Farm, Lowell, Mass. His place has been filled by the appointment of Frank G. Helyar, B.S., University of Vermont, 1905. Joseph G. Cook, B.S., assistant in animal nutrition, resigned August 1, to become superintendent of the farm at Norfolk, Mass., belonging to T. D. Cook & Co. Roy F. Gaskill, a recent graduate of the Massachusetts Agricultural College dairy course, succeeds him. E. S. Fulton, B.S., assistant chemist, severed his connection with this department September 15, having received an appointment with Dr. F. G. Benedict of Wesleyan University of Middletown, Conn., who has charge of the nutrition investigations for the United States Department of Agriculture. Mr. A. C. Whittier, B.S., University of Maine, 1905, has taken Mr. Fulton's place. The writer desires to express his highest appreciation of the faithfulness, interest and care exercised by all his co-workers in the prosecution of the various lines of work undertaken by this department during the past year.

Part II. — Experiments in Animal Nutrition.

1. Bibby's Dairy Cake.

J. B. LINDSEY.[1]

Nature and Composition of the Cake.

This material is made by J. Bibby & Sons, Liverpool, Eng., and is imported in the form of cake. It is composed chiefly of ground cotton-seed, together with locust or carob bean,[2] cereals (maize, wheat, etc.) or their by-products, fenugreek and salt: it possesses a pleasant taste and smell. A number of samples have been found that were quite mouldy, having probably been stored in a damp place. The sample used in the feeding experiment herein described had the following composition: —

	Bibby's Dairy Cake.	Standard Wheat Middlings for Comparison.	Gluten Feed for Comparison.
Water,	11.96	10.00	9.69
Ash,	7.89	4.30	1.40
Protein,	17.99	18.00	23.55
Fiber,	7.91	7.00	7.15
Extract matter,	45.05	55.70	55.08
Fat,	9.20	5.00	3.13

The cake has a high ash percentage, due partly to the presence of added salt, a moderate amount of protein and

[1] With E. B. Holland, P. H. Smith and J. G. Cook.

[2] The locust or carob tree is cultivated in Spain, the eastern Mediterranean regions and Egypt. The pods contain considerable quantities of sugar, and are eaten by both men and animals.

fiber, and quite a noticeable per cent. of fat. It is guaranteed to contain 18 to 20 per cent. of protein and 6 to 8 per cent. of fat, and usually meets these requirements. It has not been found to be very generally distributed.

Digestibility of Bibby's Dairy Cake.

The average results of six single trials with sheep are here given, together with the coefficients for standard wheat middlings and gluten feed for comparison. The full details of the digestion experiment have been reported in the seventeenth report of this station.

Coefficients of Digestibility.

	Bibby's Dairy Cake.	Standard Wheat Middlings for Comparison.	Gluten Feed for Comparison.
Dry matter,	70	73	85
Ash,	33	25	-
Protein,	66	77	85
Fiber,	31	30	76
Extract matter,	81	78	89
Fat,	92	88	83

In the several trials with Bibby's dairy cake the sheep experienced considerable difficulty in digesting the crude fiber, due probably to the fact that it was derived largely from cotton-seed hulls. It may be said that the total cake proved moderately digestible, the fiber having a low and the fat a high digestibility. Both in chemical composition and in digestibility Bibby's dairy cake closely resembled standard wheat middlings. Gluten feed contains 5 to 6 per cent. more protein, and is more digestible than the cake.

Cost of Digestible Matter.

	Bibby's Dairy Cake.	Standard Wheat Middlings.	Gluten Feed.
Pounds digestible matter in 2,000 pounds.	1,232	1,314	1,550
Cost of one pound (cents),	2.43	2.11	1.72

The above figures are based on the average wholesale prices of middlings and gluten feed for the year 1904, plus 10 per cent.; namely, $26.70 for middlings and $27.72 for gluten feed. Bibby's dairy cake cost $30 a ton. The calculations show that a ton of wheat middlings furnished rather more digestible matter than a ton of Bibby's dairy cake, and at a somewhat less cost a pound. They further show that, if 1,550 pounds of digestible matter in a ton of gluten feed could be purchased for $27.72, 1,232 pounds, being the quantity contained in a ton of Bibby's dairy cake, ought not to cost over $22. In other words, Bibby's dairy cake at $30 a ton furnishes digestible matter at some 37 per cent. advance over that contained in gluten feed at $27.72 a ton.

Feeding Experiment with Bibby's Dairy Cake, Spring, 1904.

In order to test the efficacy of this cake as a food for milk production, four cows were divided as evenly as possible into two groups, and fed by the reversal method. All of the cows received first-cut hay, rowen and bran as a basal ration. In the first half, two of the cows received a definite quantity of the dairy cake and the other two a like quantity of gluten feed; in the second half, these two grain feeds were reversed.

Duration of Experiment.

Periods.	Dates.	Gluten Feed Ration.	Bibby's Dairy Cake Ration.
I., . .	May 7 through May 27.	Red II. and Brighty.	Linnie and Blanche.
II., . .	June 4 through June 24.	Linnie and Blanche.	Red II. and Brighty.

Care of the Animals. — The cows were kept in roomy stalls, well carded, and turned into the yard some six or more hours each pleasant day.

Method of Feeding. — The animals were fed twice daily, the hay being given about an hour before milking, and the grain mixtures just before milking. The several grains were well mixed before being fed. Bibby's dairy cake was ground to the fineness of ordinary meal. Water was supplied the animals constantly by means of a self-watering device.

Character of Feeds. — The first-cut hay was a mixture of Kentucky blue-grass, timothy and red clover. The rowen was a mixture of second growth of grass and red clover, secured in good condition. The spring bran, gluten feed and Bibby's dairy cake were of good average quality.

Weighing the Animals. — The animals were weighed for three consecutive days at the beginning and end of each half of the trial.

Sampling Feeds. — The hay and rowen were sampled at the beginning, middle and end of each half of the trial, dry matter determinations made at once, and the several samples mixed for analysis. The grains were sampled daily, and preserved in glass-stoppered bottles. The cows received two ounces of salt daily.

Sampling the Milk. — The milk of each cow was sampled twice daily for five consecutive days of each week, and preserved with formaline in tightly corked bottles. The method of sampling consisted in mixing the freshly drawn milk with an especially constructed mixer, and immediately removing a small dipperful. Determinations of fat were made weekly, and solids every other week.

History of the Cows, Spring, 1904.

Name.	Breed.	Age (Years).	Last Calf dropped.	Number of Days with Calf.	Milk Yields, Beginning of Experiment (Pounds).
Red H., .	Jersey-Durham,	8	December, 1903.	59	30
Brighty, .	Grade Jersey, .	8	August, 1903.	124	17
Linnie, .	Grade Jersey, .	7	October, 1903.	65	21
Blanche, .	Grade Jersey, .	9	August, 1903.	121	22

Daily Rations consumed (Pounds).

Ration.	Cows.	Hay.	Rowen.	Bran.	Gluten Feed.	Bibby's Dairy Cake.
Gluten feed, . .	Red H., .	18	6	4	4	-
	Brighty, .	14	6	3	3	-
	Linnie, .	14	6	3	3	-
	Blanche, .	17	6	3	4	-
Bibby's dairy cake, .	Red H., .	18	6	4	-	4
	Brighty, .	14	6	3	-	3
	Linnie, .	14	6	3	-	3
	Blanche, .	17	6	3	-	4
Average, gluten feed ration.	. . .	15.75	6	3.25	3.5	-
Average, Bibby's dairy cake ration.	. . .	15.75	6	3.25	-	3.5

It will be seen that the cows received the same basal ration daily, and in addition averaged 3.5 pounds of gluten feed or dairy cake.

Average Dry Matter and Digestible Organic Nutrients in Daily Ration (Pounds).

Ration.	Dry Matter.	Digestible Organic Nutrients.					Nutritive Ratio.
		Protein.	Fiber.	Extract Matter.	Fat.	Total.	
Gluten feed, average,	24.99	2.36	4.15	7.73	.35	14.59	1: 5.4
Bibby's dairy cake, average.	24.91	2.07	3.96	7.27	.36	13.86	1: 6.0

The two rations furnished the same quantity of total dry matter daily. The Bibby's dairy cake ration contained rather less protein and about three-fourths of a pound less total digestible matter. This was due principally to the fact that Bibby's dairy cake was less digestible than the gluten feed. It would naturally be expected that Bibby's dairy cake ration would produce rather less milk, or cause the animals to shrink somewhat in live weight.

Total Yields of Milk Products (Pounds).

Ration.	Total Milk.	Average Daily Yield.	Total Solids.	Total Fat.	Butter Equivalent 85 Per Cent.
Gluten feed,	1,860.04	22.14	256.12	89.89	105.75
Bibby's dairy cake,	1,830.01	21.79	251.20	90.00	105.88

The yields obtained from the two rations, covering a period of twenty-one days in each case, were practically identical. If the periods had covered twice the length of time, the results would have been regarded as more satisfactory. Longer periods were not practicable, owing to the condition of the animals and the nearness of summer weather.

Average Composition of the Herd Milk.

Ration.	Total Solids (Per Cent.).	Fat (Per Cent.).
Gluten feed,	13.77	4.83
Bibby's dairy cake,	13.73	4.92

The two rations produced milk having practically the same composition.

Food Cost of Milk Products.

Ration.	Total Milk.	One Hundred Pounds Milk.	One Pound Butter.
Gluten feed,	$20 85	$1 12	$0 20
Bibby's dairy cake,	22 03	1 20	21
Percentage increased cost with Bibby's dairy cake.	5.66	7.14	5.00

In calculating the above results, gluten feed was charged at $27.72 a ton, Bibby's dairy cake at $30, bran at $20, hay at $15 and rowen at $14. The increased cost of the milk and butter produced by the Bibby's dairy cake ration was due to the price asked for Bibby's dairy cake.

Herd Gain or Loss in Live Weight.

Ration.	Total Gain or Loss.
Gluten feed,	43 +
Bibby's dairy cake,	2 —

There appeared to have been a slight gain in live weight produced by the gluten ration. During the Bibby's dairy cake period the weight remained constant.

Conclusions.

1. Bibby's dairy cake, a manufactured product, resembles in chemical composition and digestibility standard wheat middlings. It has a sweet taste and an agreeable flavor and odor, due to the presence of the carob bean, fenugreek and salt.

2. It was found to contain slightly less digestible matter than middlings, and some 20 per cent. less than gluten feed. On the basis of digestible matter contained in the Bibby's dairy cake and in first-class gluten feed, the former should sell for 20 per cent. less a ton.

3. While the cake is readily eaten and highly relished by

all farm animals, it is believed that the agreeable flavor and odor do not make it worth the extra price asked.

4. In the feeding experiment, lasting twenty-one days, the four cows produced practically as much milk on the Bibby's dairy cake as on the gluten feed ration; the latter ration produced a slight gain in live weight. The cost of milk and butter was noticeably more on the Bibby's dairy cake ration. The experiment indicates that the Bibby's dairy cake ration furnished a sufficient quantity of digestible matter to meet the requirements of the several cows. Had the periods been longer, and the cows in a less advanced period of lactation, it is believed the differences would have been more striking.

5. Bibby's dairy cake, at prevailing market prices, is not regarded as an economical concentrate; it can be used, however, if desired, as the exclusive grain ration for sheep, young dairy stock and milch cows. From 5 to 8 pounds would be the usual daily allowance for the latter animals. Its chief use should be as an appetizer, to be mixed in small quantities with foods that, because of an inferior flavor, would not be otherwise readily consumed.

From the standpoint of economy, farmers will do well to produce their hay, silage and corn meal, and to purchase only those manufactured concentrates that are rich in protein, such as cotton-seed meal, gluten feed, distillers' and brewers' dried grains, wheat middlings and bran.

2. Eureka Silage Corn, — its Value for Massachusetts Farmers.

J. B. LINDSEY AND P. H. SMITH.

This corn is said to have originated in Virginia. It is a large southern dent, and is considerably used for silage purposes by New England farmers.

Brooks[1] of this station compared a number of dent varieties during the season of 1901. The Eureka grew to be 15 feet high, appeared to be quite heavily leaved, and when cut, September 14, the ears were just forming. This variety yielded rather heavier than the others, producing at the rate of 24 tons to the acre, containing 8,944 pounds of dry matter. Its digestibility was not determined. Brooks concluded that the heavy dents were not as satisfactory as the smaller varieties for New England conditions. At the solicitation of Ross Bros. of Worcester, who recommend and sell the Eureka seed for silage purposes, this department has made a more thorough study of the Eureka, and briefly presents the results and conclusions in the following pages.

Crop of 1903.

One-fourth acre of medium well-drained loam, in a good state of fertility, was treated with manure from well-fed dairy cows, at the rate of 6 cords to the acre. The manure was plowed in, and the land well fitted and seeded May 26, with Eureka corn, obtained of Ross Bros. The seed came up well, and the corn made as good growth as could be expected during the exceptionally cool season. Frosts held off until nearly the 1st of October, and the corn was allowed to grow until September 25, in order to insure a maximum

[1] Fourteenth annual report of the Hatch Experiment Station, pp. 32–34.

development. At that time it averaged 11½ feet in height, the ears had formed, and the kernels were just beginning to develop. When cut, it contained 82.6 per cent. of water, and yielded at the rate of 15 tons of green material to the acre.

Crop of 1904.

One-third of an acre of well-drained, light loam was plowed, manured at the rate of 6 cords to the acre and well fitted. The area was divided into two halves, and planted with Eureka and Sibley's Pride of the North corn, the latter a medium dent that will mature its seed in our latitude. Some of the seed failed to germinate, more particularly the Eureka, which necessitated some replanting. When the corn was 15 inches high it was thinned to about one stalk to the foot. The area was kept well cultivated and free from weeds. On July 12 the corn was growing fast and looked healthy, the Eureka being the taller. August 15 the Pride of the North was well tasseled and silked, while the Eureka tassels were just showing. The corn was cut September 15, at which time the Pride of the North averaged 9 to 10 feet in height and was fairly ripe, with kernels glazing. The Eureka was 12 to 13 feet high and quite immature, the ears being small and the kernels scarcely formed. Two plats, each 175 by 35 feet, were cut, stooked and eventually carried to the barn and carefully weighed. The Eureka yielded 936 pounds of dry matter, equal to 6,683 pounds per acre, equivalent to 20.4 tons of green corn (83.6 per cent. water); the Pride of the North yielded 877 pounds of dry matter, equal to 6,262 pounds per acre, equivalent to 13.9 tons of green corn (77.5 per cent. water).

Composition of Green Corn (Per Cent.).

	Eureka.		Pride of the North, **1904.**
	1903.	**1904.**	
Water,	82.60	83.60	77.50
Ash,	1.08	1.08	1.05
Protein,	1.63	1.48	1.85
Fiber,	4.77	5.48	4.97
Nitrogen-free extract,	9.65	8.11	14.06
Fat,	.27	.25	.57
	100.00	100.00	100.00

The above analyses show that the Eureka, when cut in September, contained considerably more water and noticeably less nitrogen-free extract matter and fat than the Pride of the North.

Composition of Dry Matter (Per Cent.).

	Whole Plant.				Stover.		
	Eureka.			Pride of the North, **1904.**	Eureka, **1904.**	Pride of the North, **1904.**	Average, Forty-one Analyses, for Comparison.
	1903.		**1904.**				
Ash,	6.19[1]	7.85[2]	6.58	4.67	6.96	6.77	6.60
Protein,	9.34	9.82	9.01	8.22	8.00	7.23	7.60
Fiber,	27.41	32.70	33.43	22.11	36.49	34.45	34.20
Extract,	55.52	47.90	49.47	62.47	47.19	50.01	50.20
Fat,	1.54	1.73	1.51	2.53	1.36	1.54	1.40
	100.00	100.00	100.00	100.00	100.00	100.00	100.00

[1] When cut in autumn. [2] After being housed in barn until March.

The differences in the composition are much more noticeable with the water eliminated. The Eureka (whole plant) contained decidedly more ash and fiber, rather more protein and much less extract matter than the Pride of the North.

The analyses show that the Pride of the North had reached a more advanced stage of development than the Eureka, and consequently contained a much larger proportion of starchy matter. The stover from the two varieties was quite similar in composition.

Percentage of Water in Field-cured Material.

Eureka.			Pride of the North.	
Whole Plant.		Stover.	Whole Plant.	Stover.
59.92[1]	68.92[2]	62.89[3]	37.84[4]	18.13[5]

[1] After being cured in barn for six months, 1903. [2] As it came from field, 1904.
[3] After being in barn about a month, 1904. [4] As it came from field, 1904.
[5] After being in barn about three months.

The field-cured Eureka still continued to contain a high moisture content, due probably to its immaturity and to its unusually coarse, porous stems.

The Pride of the North had about the usual water content for matured corn that had been field cured. These figures show that in a ton of dried Eureka fodder, as drawn to the barn, there would be 1,380 pounds of water and 620 pounds of dry matter: and in a ton of Pride of the North there would be 757 pounds of water and 1,243 pounds of dry matter; in other words, each ton of Pride of the North would have twice the feeding value of Eureka, without taking into consideration the superior nutritive character of the dry matter, which will be alluded to under another heading.

The corn stover derived from the two varieties likewise showed marked differences in the water percentage present. The barn-cured Pride of the North stover was exceptionally dry.

Composition of Parts of Corn (Per Cent.).

[Dry Matter.]

	Leaves.		Stalks.		Ears.		Husks.	
	Eureka.	Pride of the North.	Eureka.	Pride of the North.	Eureka.	Pride of the North.	Eureka.	Pride of the North.
Ash,	8.98	9.42	5.42	5.81	3.25	1.95	3.02	3.17
Protein,	14.53	14.53	4.80	4.55	12.00	9.82	8.66	5.40
Fiber,	28.43	25.00	35.77	31.94	19.47	11.37	24.64	27.32
Extract,	45.63	47.63	52.94	56.82	63.84	73.65	62.22	62.70
Fat,	2.43	3.42	1.07	.88	1.44	3.21	1.46	1.41
	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

The samples were taken immediately after the corn was cut (September 15), dried at a low heat, and preserved in glass-stoppered bottles. The leaves of the two varieties were similar in composition, and are the most valuable parts of the plant, aside from the ears. The stalks of the Eureka were characterized by containing more fiber than the other variety. The ears produced by the Eureka contained rather more protein and ash, decidedly more fiber and noticeably less fat and extract matter than those yielded by the Pride of the North. The analyses make clear that the ears obtained from the Eureka were quite imperfectly developed. The composition of the husks was more uniform.

Digestibility of the Corn.

The first digestion experiment was made in the autumn of 1903, with the Eureka green corn. Another experiment was made with the same corn, after it had been cured and housed for six months. Unfortunately, a digestion test was not made with the Pride of the North (whole plant). During the autumn of 1905, therefore, another sample of this variety was tested for digestibility. It was fully developed and well eared. Other experiments were made to test the digestibility of the stover of each of the two varieties produced in 1904. The several tests were made with the same sheep in each case, the results of which follow: —

	Eureka.		Pride of the North, Green, **1905** (Two Sheep).	Eureka, Stover, **1904** (Two Sheep).	Pride of the North, Stover, **1904** (Two Sheep).
	Green, **1903** (Three Sheep).	Dry, **1903** (Two Sheep).			
Dry matter,	67	64	71	54	54
Ash,	42	40	34	45	31
Protein,	67	57	63	48	45
Fiber,	60	72	65	59	60
Nitrogen-free extract,	72	64	77	53	54
Fat,	66	62	76	67	64

The green Eureka fodder (whole plant) and the same material dried showed only slight variation in the digestibility of total dry matter. The results correspond closely with those obtained by other experimenters with large southern varieties at a similar stage of growth. For some reason the fiber in the dry material was more fully digested than in the green substance, and the protein and extract matter less so. The Pride of the North (whole plant) proved to be rather more digestible than the Eureka, due to the fact that it was well eared. The digestible material in the Pride of the North, because of its content of matured grain, would naturally yield more net available energy than a like amount of digestible matter derived from the Eureka. The corn stover (all ears removed) from each of the two varieties appeared to be equally well digested.

Summary of Yields.

A definite quantity of each of the two varieties of green material was separated into husks, ears, leaves and stalks, in order to determine the relative proportions of each. The figures show percentages or pounds in 100.

(*a*) *Yield of Parts.*

Parts.	Eureka.			Pride of the North.		
	First Trial.	Second Trial.	Average.	First Trial.	Second Trial.	Average.
Husks,	6.50	8.00	7.25	10.25	11.25	10.75
Ears,	6.25	8.25	7.25	21.25	23.00	22.11
Leaves,	22.75	21.75	22.25	20.00	20.00	20.00
Stalks,	65.00	62.25	63.62	47.50	46.00	46.75
	100.50	100.25	100.37	99.00	100.25	99.67

The results are in accordance with the teaching of the analytical data. The Eureka showed only 7.25 per cent. of ears, while the Pride of the North contained 22.11 per cent. The Pride of the North variety consisted of 46.75 per cent. of stalks, and the Eureka 63.62 per cent. The Eureka, even at its less advanced stage of growth, contained only slightly more leafy matter than the Pride of the North.

(*b*) *Yield per Acre* (*Pounds*).

	Eureka.		Pride of the North, **1904.**
	1903.	**1904.**	
Green material,	30,000	40,800	27,800
Dry matter,	5,220	6,691	6,255
Estimated digestible matter,	3,497 [1]	4,483 [1]	4,441 [1]

[1] Obtained by allowing 67 per cent. of the dry matter to be digestible in the Eureka, and 71 per cent. in the Pride of the North, as determined by actual experiment.

The above results indicate strongly that the Eureka, although a larger variety, yielding considerable more green material than the Pride of the North, is not likely to furnish any more actual food to the acre. In the present instances,

the party drawing the product of an acre of green Eureka corn to the barn would be transporting 34,109 pounds of water and 6,691 of dry matter, while in the case of the Pride of the North he would cart 21,545 pounds of water and 6,255 pounds of dry material; in other words, to secure essentially the same quantity of actual food in the Eureka he would be required to handle 12,564 pounds extra water.

It is, of course, understood that the yield would vary from year to year, depending on soil and climatic conditions. It is believed, however, that the relative proportions would hold true, and that the farmer would secure as much actual food material from those varieties of corn that mature their seed, without being obliged to handle the extra bulk in the form of water.

Conclusions.

1. Eureka silage corn is a late dent variety; it has large stalks, which appear to be thickly set with leaves. During the seasons of 1903 and 1904 it grew 11 to 13 feet high, and when cut, September 15, the ears were very immature (kernels just forming).

2. In comparison with Sibley's Pride of the North, a medium dent, which matures its ears in this latitude, the Eureka green corn, when cut, contained about 6 per cent. more water, noticeably more ash and fiber, and much less extract matter. The field-cured fodder of the Eureka still contained as high as 69 per cent. of water, while the Pride of the North contained only 38 per cent.

3. The leaves and husks of each variety did not vary greatly in composition. The ears and stalks of the Eureka contained more fiber and much less extract matter and fat than those of the Pride of the North.

4. The Eureka green fodder was found to be 67 per cent., and the same material dry 64 per cent., digestible; a typical sample of Pride of the North, cut green, was 71 per cent. digestible. The stover of both varieties proved equally digestible.

5. The Eureka yielded about the same relative weight of green leaves as did the Pride of the North. It produced 64 per cent. of stalks and 7 per cent. of ears, while the Pride

of the North yielded 47 per cent. of stalks and 22 per cent. of ears.

6. The Eureka produced at the rate of 20 tons of green fodder, and the Pride of the North 13 tons of green fodder, to the acre. The latter, however, contained nearly as much dry and digestible matter (actual food material) as did the former. The excess yield of Eureka green corn, therefore, consisted of water.

7. Had the seasons of 1903 and 1904 been more favorable to the growth of corn, it is probable that both varieties would have produced larger yields. It is very doubtful, however, if the Eureka would have matured its grain.

The writer, therefore, thinks it unwise to grow such late dents as the Eureka, and believes the northern farmer will secure better feed for less money by holding fast to those varieties that will mature not later than September 10 or 15.

It is well known that immature corn, such as the Eureka, undergoes more serious decomposition when ensiled than do well-matured varieties, which would still further detract from its nutritive value.

3. Concerning Wheat Bran.

J. B. LINDSEY.[1]

(1) *Introduction.*

Until within comparatively recent times, wheat bran and corn meal have formed the two staple concentrated feeds for dairy stock, and in spite of the large variety of concentrates now in the market, the former still continues to be used largely by the great majority of dairymen in our eastern States. The reasons for this are not difficult to find. A good quality of bran is uniformly palatable: it can be fed in considerable quantities without producing any ill effects: it acts as a slight laxative: it furnishes more digestible protein than corn; and it serves as a very satisfactory diluter or distributer of the heavy concentrates, such as the glutens, cotton-seed meal and flour middlings. It is believed, however, that the nutritive material contained in bran can be purchased more cheaply in other concentrates, and that New England farmers often use more of it than economy warrants.

Attention is called in the present paper to the composition, digestibility, cost of digestible matter and the fertilizer ingredients in bran, as compared with other concentrated feeds, and likewise to experiments I. and II., in which corn silage is compared with wheat bran as a distributer of the heavy concentrates. Note particularly the brief discussion of the results, at the end of the article.

[1] With E. B. Holland, P. H. Smith and J. G. Cook.

(2) *Average Composition of Concentrates.*

Ingredients.	Wheat Bran.	For Comparison.				
		Cotton-seed Meal.	Gluten Feed.	Distillers' Dried Grains.	Brewers' Dried Grains.	Malt Sprouts.
Water,	10.00	7.00	8.50	8.00	8.00	11.00
Ash,	6.40	6.50	1.70	1.70	3.80	5.80
Protein,	16.00	45.10	26.50	33.00	23.10	27.10
Fiber,	10.00	6.10	7.20	13.10	10.80	11.80
Extract matter (starchy),	53.00	24.20	53.10	32.40	49.40	42.90
Fat,	4.60	11.10	3.00	11.80	4.90	1.60

Wheat bran contains noticeably less protein than any of the other important by-products. Nitrogen-free extract matter usually is the fodder group next in value to the protein. The quantity contained in bran is approximately equal to that found in gluten feed, and not greatly in excess of the percentage in brewers' grains and malt sprouts.[1] Most of the several feeds enumerated contain about similar fiber percentages.

(3) *Digestibility of the Concentrates.*

The figures in the following table show the pounds of digestible fodder groups contained in one ton of the several feeds.

Wheat bran is shown to contain rather less total digestible matter and noticeably less digestible protein than any of the several feeds tabulated. The two carbohydrate feeds, corn and hominy meals, are naturally deficient in protein, but very rich in digestible starchy matter and fat.

[1] The quantity of extract matter in cotton-seed meal is quite small, due to the exceptionally high protein percentage.

Organic Matter digestible in 2,000 Pounds.

INGREDIENTS.	Wheat Bran.	Cotton-seed Meal.	Gluten Feed.	Brewers' Dried Grains.	Malt Sprouts.	Distillers' Dried Grains.	Corn Meal.	Hominy Feed.
Protein,	254	800	440	364	434	448	130	142
Fiber,	58	68	110	114	78	160	-	44
Extract matter,	732	298	964	574	580	520	1,328	1,110
Fat,	60	196	50	90	32	206	60	152
Totals,	1,104	1,362	1,564	1,142	1,124	1,334	1,518	1,448

Retail Cost of One Pound of Digestible Matter.

	Spring and Winter Bran. **1901** to **1904.**	Cotton-seed Meal. **1901** to **1904.**	Gluten Feed. **1901** to **1904.**	Distillers' Dried Grains. **1904** to July, **1905.**	Brewers' Dried Grains. **1904.**	Malt Sprouts. **1904** to July, **1905.**	Corn Meal. **1901** to **1904.**	Hominy Meal. **1901** to **1904.**
Market price per ton,	$22 48	$29 17	$26 05	$27 00	$22 50	$21 00	$26 12	$25 03
Cost of one pound of digestible matter (cents),	2.04	2.15	1.67	2.03	1.97	1.87	1.70	1.72

The above figures are quite instructive. They show that digestible matter in bran, cotton-seed meal and distillers' and brewers' dried grains has cost about the same for a number of years, while in the form of malt sprouts the price has been somewhat less.[1] Corn and corn by-products (gluten and hominy feed) have furnished digestible matter for uniformly less money than it could be purchased for in the form of either bran, cotton-seed meal, distillers' or brewers' residues.

Retail Cost of Digestible Protein.

[Allowing 1 cent for digestible carbohydrates, .5 cent for digestible fiber and 2.25 cents for digestible fat.]

	Spring and Winter Bran. **1901** to **1904.**	Cotton-seed Meal. **1901** to **1904.**	Gluten Feed. **1901** to **1904.**	Distillers' Grains. **1904** to July, **1905.**	Brewers' Grains. **1904.**	Malt Sprouts. **1904.**
Market price per ton, .	$22 48	$29 17	$26 05	$27 00	$22 50	$21 00
Cost of one pound of digestible protein (cents).	5.40	2.72	3.00	3.65	3.91	3.25

Cotton-seed meal furnishes digestible protein for the least money, gluten feed standing next in order, while protein in the form of wheat bran is decidedly expensive. Naturally, carbohydrate feeds, corn and the like, are not economical sources of protein.

(4) *Fertilizing Ingredients in a Ton of Concentrates.*

	Wheat Bran.	Cotton-seed Meal.	Gluten Feed.	Distillers' Grain.	Brewers' Grains.	Malt Sprouts.
Nitrogen, ...	51	144	85	106	74	86
Potash, ...	28	37	-	-	17	33
Phosphoric acid, . .	42	50	7	60	21	29
Valuation per ton, . .	$12 34	$30 18	$16 00	$19 78	$15 25	$18 47
Percentage valuation of retail cost.	54	103	62	73	68	88

Bran is quite rich in the mineral ingredients phosphoric acid and potash, being exceeded only by cotton-seed meal.

[1] The retail price of malt sprouts and brewers' dried grains has been rather difficult to ascertain, for the reason that comparatively small quantities are sold in Massachusetts markets.

The corn by-products (gluten feed and distillers grains) contain only a trace of potash. The money valuations are based on current market prices, namely: nitrogen, 18.5 cents; potash, 4.25 cents; and phosphoric acid, 4 cents a pound. The fertilizing elements in the several feeds are in as desirable a form as those in the best grades of unmixed fertilizing stock. Bran is shown to contain fertilizer ingredients equal to 54 per cent. of its cost, and cotton-seed meal is fully equal to its cost; the others are considerably in excess of the bran.

It is not to be inferred that after the several feeds have passed through the animal their fertilizing ingredients have as high a money value as before they were consumed. In fact, some 20 per cent. has been retained by the animal, more or less loss has unavoidably occurred in the manurial residue, and they are in a much more bulky condition, which requires considerable additional labor to apply them. Nevertheless, the figures show clearly that the combined fertilizer ingredients in bran have noticeably less value than in any of the other by-products.

Conclusions.

1. Wheat bran contains noticeably less total as well as less digestible protein than any of the other nitrogenous by-products.

2. The total digestible matter in bran is likewise less than in the other prominent concentrates; thus, cotton-seed meal contains 24 per cent. more, gluten feed 44 per cent., distillers' grains 21 per cent. and corn meal 38 per cent.

3. For several years past the cost of a pound of digestible matter in bran, cotton-seed meal, distillers' and brewers' dried grains has been about the same; it could be purchased in the form of gluten feed, corn and hominy meals for some 20 per cent. less.

4. A pound of digestible protein in wheat bran cost 100 per cent. more than in cotton-seed meal, 80 per cent. more than in gluten feed and 50 per cent. more than in distillers' dried grains.

5. Because of its relatively low protein percentage, the

fertilizer ingredients in bran have from 10 to 50 per cent. less money value than those contained in the other by-products.

6. The nutritive material and especially the protein contained in wheat bran must be regarded, therefore, as relatively expensive. Because of its palatability, its laxative effect and its desirability as a diluter or distributer of the heavy concentrates, it will continue to be used by many farmers as a portion of the grain ration for dairy stock. See practical deductions as to the use of bran, on page 114.

(5) *Wheat Bran* v. *Corn Silage as a Distributer of the Heavy Concentrates.*

EXPERIMENT I. SPRING, 1903.

Object of the Experiment. — Wheat bran has been shown to be an expensive feed, judged solely from the amount of nutritive material it contains. The present experiment was undertaken to see if silage would not serve as a distributer equally as well as bran. Such being the case, the farmer could use *home-grown* corn, or corn and cob meal, in place of an equal amount of bran, and, by feeding in addition a few pounds daily of cotton-seed meal and malt sprouts or flour middlings, get along with a minimum quantity of *purchased* grain.

Plan of the Experiment. — The cows, ten in number, were high-grade Jerseys. Eight had calved early the previous autumn, and two, Pearl and Red 2d, the preceding December.

The animals were divided as equally as possible into two lots of five each, and both herds fed for two weeks upon the so-called bran ration, consisting of silage, hay, cotton-seed meal, flour middlings and wheat bran. In the second period, lasting five weeks, one lot of cows, known as Herd I., continued to receive the same ration; and the other lot, Herd II., was fed the so-called silage ration, consisting of silage and hay, cotton-seed meal, flour middlings and corn and cob meal. In each of the two periods one week was considered preliminary.

In interpreting the results, it is proposed to note the weekly yields produced in the second period by both herds on different grain rations, as compared with the weekly yields of the first periods, when the two herds received the same grain ration, thus ascertaining the comparative efficacy of the two different grain rations fed in the second period. The yields obtained in the first period are to be used simply as a basis for comparison.

Duration of the Experiment.

Period I.

Herd.	Character of Ration.	Cows.	Date.	Number of Weeks.
I., .	Bran as distributer,	Brighty, Pearl, Linnie, Roda, Doliska.	March 30[1]–April 5.	1
II., .	Bran as distributer,	Red II., Dora, Blanche, May, Daisy.	March 30–April 5.	1

Period II.

I., .	Bran as distributer,	Brighty, Pearl, Linnie, Roda, Doliska	April 12[1]–May 10.	4
II., .	Silage as distributer,	Red II., Dora, Blanche, May, Daisy.	April 12–May 10.	4

[1] Preceded by preliminary period of seven days.

General Care of the Animals. — The experiment was carried out in the station barn, especially set apart for such work. Each animal was kept in a roomy stall, well carded, and turned daily into a yard for exercise. The cows were in good condition, and quite contented.

Method of Feeding. — The cows were fed twice daily, and water was before them constantly. In case of the bran ration, the several grains composing it were carefully mixed, and fed just before milking. The grains used in the silage ration — cotton-seed and corn meals and flour middlings — were likewise mixed, and the resulting combination quite thoroughly mingled with the silage by means of a four-tined fork, and fed previous to milking. One quart of the bran ration weighed .80 of a pound, and 1 quart of the grain ration fed with the silage weighed 1.4 pounds, the former being naturally much more bulky.

Character of the Feed Stuffs. — The bran was from spring wheat, the other grains were of the usual good quality. The silage, made from rather poorly eared corn, was of average quality. The hay was largely Kentucky blue-grass, with some clover.

Weighing the Animals. — The animals were weighed on three consecutive days at the beginning and end of the second period.

Sampling Feeds. — The coarse fodders were sampled three times during the second period, dry matter determinations made immediately, and composite samples analyzed. Small samples of the grains were taken daily and placed in glass-stoppered bottles.

Sampling Milk. — The milk of each cow was sampled twice daily for five consecutive days of each week of the two periods, and preserved with formaline in tightly corked bottles. The method of sampling consisted in mixing the freshly drawn milk with an especially constructed mixer, and immediately removing a small dipper full.

Average Ration consumed by Each Cow Daily (Pounds).

First period: both herds, bran ration.

Herd.	First Cut Hay.	Silage.	Bran.	Cotton-seed Meal.	Flour Middlings.	Corn and Cob Meal.
I., . . .	12.52	26.10	3.60	2.00	2.00	-
II., . . .	13.60	29.00	3.80	2.10	2.10	-
Second period: Herd I., bran ration; Herd II., silage ration.						
I., . . .	12.80	25.70	3.60	2.00	2.00	-
II., . . .	13.60	29.00	-	2.10	2.10	3.80

Herd I. received practically the same quantity of grain and roughage daily in each period; the same can be said of Herd II. Herd II. needed and received slightly more than Herd I. during both periods.

Average Dry and Digestible Daily Nutrients consumed by Each Cow (Pounds).

Herd I.: both periods, bran ration.

Period.	Dry Matter.	Protein.	Carbo-hydrates.	Fat.	Total.	Nutritive Ratio.
I., ...	22.98	2.42	11.38	.69	14.49	1:5.4
II., ...	23.16	2.43	11.46	.69	14.58	1:5.4
Herd II.: first period, bran ration; second period, silage ration.						
I., ...	24.85	2.58	12.36	.74	15.68	1:5.4
II, ...	24.78	2.26	13.29	.73	16.28	1:6.5

Herd I. received the same quantity of digestible nutrients during both periods. Herd II. received more total digestible matter in the first period than did Herd I., but the nutritive ratio of the fodder groups was the same. In the second or silage period Herd II. consumed rather more total digestible nutrients than in the first period, but less digestible protein, the nutritive ratio being somewhat wider (1 : 6.5, instead of 1 : 5.4). This increase of digestible matter consumed was due to the higher digestibility of the corn and cob meal.

Weight of Animals at Beginning and End of Second Period (Pounds).

Herd.		Brighty.	Pearl.	Linnie.	Roda.	Doliska.	Red II.	Dora.	Blanche.	May.	Daisy.	Gain or Loss.
I., .	Beginning, .	850	958	815	860	761	-	-	-	-	-	+67
	End, . .	874	967	828	864	778	-	-	-	-	-	
II., .	Beginning, .	-	-	-	-	-	1,003	875	1,168	1,048	850	+94
	End, . .	-	-	-	-	-	1,003	905	1,177	1,076	877	

Each herd made a slight gain during the period. The difference is unimportant.

Yield of Milk and Milk Ingredients (Pounds).

First period: both herds, bran ration.

Herd.	Cows.	Total Milk.	Daily for Cow.	Total Solids.	Total Fat.	Butter Equivalent (85 Per Cent.).
I.,	Brighty,	127.25	18.18	20.06	8.21	9.66
	Pearl,	218.00	31.14	29.89	10.90	12.82
	Linnie,	157.00	22.43	22.62	8.48	9.98
	Roda,	110.74	15.82	15.32	5.65	6.65
	Doliska,	184.99	26.43	23.29	7.03	8.27
Total,		797.98	114.00	111.18	40.27	47.38
II.,	Red II.,	262.49	37.50	32.31	11.02	12.96
	Dora,	142.60	20.37	20.29	7.27	8.55
	Blanche,	150.62	21.52	22.61	7.91	9.31
	May,	139.50	19.93	21.41	7.88	9.27
	Daisy,	123.00	17.57	19.45	7.38	8.68
Total,		818.21	116.89	116.07	41.46	48.77

Second period: Herd I., bran ration; Herd II., silage ration.

I.,	Brighty,	509.74	18.21	80.84	32.41	38.13
	Pearl,	879.70	31.42	125.70	46.44	54.65
	Linnie,	679.00	24.25	97.84	36.60	43.06
	Roda,	439.82	15.71	62.37	22.17	26.08
	Doliska,	773.21	27.61	97.73	29.15	34.30
Total,		3,281.47	117.20	464.48	166.77	196.22
II.,	Red II.,	1,048.58	37.45	131.91	43.62	51.32
	Dora,	581.83	20.78	85.65	31.48	37.04
	Blanche,	609.73	21.78	92.25	32.01	37.66
	May,	497.49	17.77	78.11	27.96	32.89
	Daisy,	480.68	17.17	77.53	29.99	35.28
Total,		3,218.31	114.95	465.45	165.06	191.19

Average Weekly Yields of Each Herd (Pounds), and Percentage Gain or Loss.

Herd I.

Periods.	Milk.	Solids.	Fat.	Butter Equivalent (85 Per Cent.).
I.,	798.0	111.2	40.3	47.4
II.,	820.4	116.1	41.7	49.1
Percentage gain or loss, II. over I.,	+2.8	+4.4	+3.5	+3.6

Herd II.

Periods.	Milk.	Solids.	Fat.	Butter Equivalent (85 Per Cent.).
I.,	818.2	116.1	41.5	48.8
II.,	804.6	116.4	41.3	48.5
Percentage gain or loss, II. over I.,	—1.7	+.3	—.4	—.6

It will be seen that Herd I., which received the bran ration during both periods, made a slight gain during the second period in the quantity of milk and milk ingredients; while Herd II., which received the silage ration in the second period, underwent a slight loss. The differences are so slight as to prevent any positive conclusions. They indicate, however, that the bran ration produced slightly better results than the silage ration, due possibly to the excess of protein in the former ration.

Dry and Digestible Matter required to produce Milk, Milk Solids and Milk Fat.

Herd I.: both periods, bran ration.

Period.	Dry Matter required to produce —			Digestible Matter required to produce —		
	One Hundred Pounds Milk.	One Pound Solids.	One Pound Fat.	One Hundred Pounds Milk.	One Pound Solids.	One Pound Fat.
I.,	100.80	7.23	19.97	63.56	4.56	12.60
II.,	98.81	6.98	19.44	62.21	4.40	12.24

Herd II.: first period, bran ration; second period, silage ration.

Period.	Dry Matter: One Hundred Pounds Milk.	One Pound Solids.	One Pound Fat.	Digestible Matter: One Hundred Pounds Milk.	One Pound Solids.	One Pound Fat.
I.,	106.32	7.49	20.98	67.01	4.73	13.23
II.,	107.78	7.45	21.01	70.83	4.90	13.81

Herd I. required slightly less dry and digestible matter to make milk and milk ingredients in the second period. Herd II. took a little more dry and digestible matter in the second period to make a definite quantity of milk, milk solids and milk fat. On the basis of the above figures, it may be concluded that the bran ration produced a trifle better results than the silage ration.

Food Cost of Milk and Butter.

Herd I.: both periods, bran ration.

Period.	One Hundred Pounds Milk.	One Hundred Pounds Butter.
I.,	$1 03	$17 33
II.,	1 01	16 81

Herd II.: first period, bran ration; second period, silage ration.

Period.	One Hundred Pounds Milk.	One Hundred Pounds Butter.
I.,	$1 08	$18 11
II.,	1 13	18 74
Percentage increased cost, Period II. over Period I.	+4.6	+3.5

The cost of milk and butter is based upon hay at $15 a ton, silage at $3.50, bran at $22, corn and cob meal at $26, cotton-seed meal at $30 and middlings at $25. The cost of milk and butter produced by Herd I. in both periods was nearly identical, and the slight variations may be attributed to experimental error. The increased cost of the milk and butter produced by Herd II. in the second period was due largely to the then existing excess cost of the corn and cob meal over that of the bran, and not to the feeding effect of the two rations.

Fertilizer Ingredients in Rations (Cost).

First period: Herd I., bran ration.

19.46 pounds nitrogen, valued at	$3 31
13.81 pounds potash, valued at	69
7.75 pounds phosphoric acid, valued at	31
Total,	$4 31

Fertilizer Ingredients, etc. — Concluded.

First period: Herd II., bran ration.

20.90 pounds nitrogen, valued at	$3 55
14.98 pounds potash, valued at	75
8.26 pounds phosphoric acid, valued at . . .	33
Total, ...	$4 63

Second period: Herd I., bran ration.

78.16 pounds nitrogen, valued at	$13 29
55.65 pounds potash, valued at	2 78
31.02 pounds phosphoric acid, valued at . .	1 24
Total, ...	$17 31

Second period: Herd II., silage ration.

78.38 pounds nitrogen, valued at	$13 32
54.89 pounds potash, valued at	2 74
24.86 pounds phosphoric acid, valued at . . .	99
Total, ...	$17 05

The total quantity and valuation of fertilizer ingredients were nearly identical in each ration.

Conclusions.

1. The animals were in good condition during the entire experiment, hence the silage proved equally as satisfactory as bran for distributing the heavy concentrates (cotton-seed meal and flour middlings).

2. The so-called bran ration produced a trifle more milk and milk ingredients than did the silage ration. Furthermore, it required a little less dry and digestible matter to make a definite quantity of milk ingredients with the former ration.

3. It cost several per cent. more to produce milk with the silage ration; but this difference was due primarily to the temporarily increased market price of the corn and cob meal, and not to the feeding effect of the ration.

EXPERIMENT II. — WINTER, 1904.

Object of the Experiment. — The object of this experiment was quite similar to the one already described; namely, to see if corn silage could not be employed in place of wheat bran as a distributer of the heavy concentrates.

Plan of the Experiment. — This experiment was conducted on the reversal plan. The cows were divided into two lots of four each. In the first half of the experiment one lot received the so-called bran ration at the same time the other lot received the silage ration. In the second half these conditions were reversed.

Duration of Experiment.

First Half.

CHARACTER OF RATION.	Date.	Number of Weeks.	Cows.
Bran as distributer,	January 16 through February 26.	6	Blanche, Brighty, Doliska, Dora.
Silage as distributer,	January 16 through February 26.	6	Daisy, Linnie, May, Roda.

Second Half.

CHARACTER OF RATION.	Date.	Number of Weeks.	Cows.
Bran as distributer,	March 5 through April 15.	6	Daisy, Linnie, May, Roda.
Silage as distributer,	March 5 through April 15.	6	Blanche, Brighty, Doliska, Dora.

Care of Animals and of the Product. — The general care of the animals and the method of feeding and of sampling the milk have been described in the preceding experiment. Each cow was weighed for three consecutive days at the beginning and end of each half of the experiment, the weighing being done in the afternoon before feeding and watering.

Character of the Feeds. — The weights of a quart of the two grain mixtures were about the same as those fed in the former experiment, the bran ration being much the more bulky. The bran was derived from winter wheat, and was light and flaky. Corn meal was used in place of corn and cob meal, the latter not being available. The cotton-seed meal and flour middlings were of the usual good quality.

The silage was largely corn, with a slight admixture of soy beans. The corn and soy beans were grown together, but, owing to the cool summer of 1903, the beans made a very light growth and produced scarcely any seeds. The corn, likewise, was poorly eared, and the total yield of the mixture was only about 8 tons to the acre. The silage was not at all decomposed or unduly acid, and was considered of fair quality. The hay was largely Kentucky blue-grass, of good quality, cut when in full to late blossom.

Rations consumed Daily (Pounds).

Wheat Bran Ration.

Cows.	First Cut Hay.	Silage.	Bran.	Corn Meal.	Flour Middlings.	Cotton-seed Meal.
Blanche,	16.0	34.6	3.5	-	2.0	1.5
Brighty,	13.0	30.0	3.0	-	2.0	1.0
Doliska,	12.0	30.0	3.0	-	2.0	1.0
Dora,	13.0	30.0	3.0	-	2.0	1.0
Daisy,	13.0	30.0	3.0	-	2.0	1.0
Linnie,	15.0	30.0	3.0	-	2.0	1.0
May,	16.0	30.0	3.0	-	2.0	1.0
Roda,	12.0	30.0	3.0	-	2.0	1.0
Average,	13.8	30.6	3.1	-	2.0	1.1

Silage Ration.

Cows.	First Cut Hay.	Silage.	Bran.	Corn Meal.	Flour Middlings.	Cotton-seed Meal.
Blanche,	15.0	35.0	-	3.0	2.0	2.0
Brighty,	12.0	30.0	-	2.5	2.0	1.5
Doliska,	11.0	28.1	-	2.2	2.0	1.4
Dora,	12.0	30.0	-	2.5	2.0	1.5
Daisy,	12.0	30.0	-	2.5	2.0	1.5
Linnie,	14.0	30.0	-	2.5	2.0	1.5
May,	14.0	26.9	-	2.3	1.8	1.4
Roda,	11.0	30.0	-	2.5	2.0	1.5
Average,	12.6	30.0	-	2.5	2.0	1.5

Dry and Digestible Matter in Daily Rations (Pounds).

Wheat Bran Ration.

Cows.	Dry Matter.	Digestible Organic Nutrients.					Nutritive Ratio.
		Protein.	Fiber.	Extract Matter.	Fat.	Total.	
Blanche,	27.12	2.54	4.36	8.45	.63	15.98	1:5.6
Brighty,	22.66	2.09	3.61	7.21	.53	13.44	1:5.7
Doliska,	21.78	2.04	3.43	6.98	.52	12.97	1:5.7
Dora,	22.66	2.09	3.61	7.21	.53	13.44	1:5.7
Daisy,	22.66	2.09	3.61	7.21	.53	13.44	1:5.7
Linnie,	24.44	2.18	3.97	7.67	.54	14.36	1:5.9
May,	25.33	2.23	4.15	7.89	.55	14.82	1:6.0
Roda,	21.78	2.04	3.43	6.98	.52	12.97	1:5.7
Average,	23.55	2.16	3.77	7.45	.54	13.92	1:5.7

Silage Ration.

Cows.	Dry Matter.	Protein.	Fiber.	Extract Matter.	Fat.	Total.	Nutritive Ratio.
Blanche,	26.28	2.46	4.15	9.03	.68	16.32	1:5.9
Brighty,	21.76	2.03	3.40	7.60	.57	13.60	1:6.0
Doliska,	20.15	1.90	3.14	7.03	.53	12.60	1:6.0
Dora,	21.76	2.03	3.40	7.60	.57	13.60	1:6.0
Daisy,	21.76	2.03	3.40	7.60	.57	13.60	1:6.0
Linnie,	23.53	2.13	3.76	8.06	.58	14.53	1:6.2
May,	22.49	2.00	3.63	7.61	.54	13.78	1:6.2
Roda,	20.87	1.99	3.22	7.38	.56	13.15	1:6.0
Average,	22.33	2.07	3.51	7.74	.58	13.90	1:6.0

Average Daily Rations (Pounds).

Character of Rations.	Hay.	Silage.	Bran.	Corn Meal.	Flour Middlings.	Cotton-seed Meal.
Bran,	13.8	30.6	3.1	-	2.0	1.1
Silage,	12.6	30.0	-	2.5	2.0	1.5

Average Dry and Digestible Nutrients in Daily Rations (Pounds).

Character of Ration.	Dry Matter.	Digestible Organic Nutrients.				Nutritive Ratio.
		Protein.	Carbo-hydrates.	Fat.	Total.	
Bran,	23.55	2.16	11.22	.54	13.92	1:5.7
Silage,	22.33	2.07	11.25	.58	13.90	1:6.0

The average daily bran ration, consisting approximately of 14 pounds of hay, 31 pounds of silage (about a bushel), 3 pounds of bran, 2 pounds of flour middlings and 1 pound of cotton-seed meal, may be considered a good type of a dairy ration, and quite similar to combinations in use by many milk producers who buy all of their grain. It was the aim in preparing the silage ration to do away with the bran by substituting home-grown corn, and at the same time to produce a combination that would contain essentially the same quantity and proportion of digestible nutrients. This was accomplished by feeding 2.5 pounds of corn meal instead of 3 pounds of bran, and 1.5 pounds of cotton-seed meal in place of the 1 pound fed in the bran ration.

Assuming that the farmer produced the hay, silage and corn meal in the ration, he would only use 3.5 pounds daily of purchased grain, costing 4.7 cents, while the bran ration would require a daily cash outlay for grain of 7.25 cents.

The two rations contained almost identical quantities of digestible protein and of total digestible nutrients. Both rations appeared to be equally well relished by the animals. The entire herd consumed the bran ration without the least irregularity, while on the silage ration the cow May suffered an attack of indigestion which caused her to shrink noticeably in her milk, and rendered it necessary to reduce her feed for some ten days. Whether this disturbance may be attributed to the character of the ration, or to other causes, it is difficult to state with certainty. Cow Doliska, while receiving the silage ration, underwent an attack of mammitis in one quarter of the udder, which decreased her milk yield, and made it necessary to take away temporarily a considerable portion of her grain ration. This cow was producing a large yield of milk during the experiment, but was not in first-class physical condition. It seems probable that her condition rendered her sensitive to the combination of heavy grain, even though it was distributed through the silage.

Weight of Animals at Beginning and End of Experiment (Pounds).

Wheat Bran Ration.

	Blanche.	Brighty.	Doliska.	Dora.	Daisy.	Linnie.	May.	Roda.	Total Gain or Loss.
Beginning,	1,176	832	753	887	842	841	1,020	852	+29
End,	1,146	841	741	876	863	854	1,024	887	

Silage Ration.

	Blanche.	Brighty.	Doliska.	Dora.	Daisy.	Linnie.	May.	Roda.	Total Gain or Loss.
Beginning,	1,121	838	714	868	823	828	1,013	831	+18
End,	1,133	836	720	884	830	823	990	838	

The animals practically maintained their weight on each of the rations.

Yield of Milk and Milk Ingredients, with Percentage Gain or Loss (Pounds).

Wheat Bran Ration.

Cows.	Total Milk.	Daily Milk.	Total Solids.	Total Fat.	Butter Equivalent. 1/6 added.
Blanche,	1,004.08	23.91	145.19	51.51	60.10
Brighty,	790.62	18.82	122.39	49.73	58.02
Doliska,	1,105.37	26.32	131.97	40.24	46.95
Dora,	909.16	21.65	126.10	44.28	51.66
Daisy,	715.10	17.03	110.05	41.48	48.39
Linnie,	914.35	21.77	130.57	48.92	57.07
May,	834.73	19.87	123.51	43.99	51.32
Roda,	834.03	19.86	115.93	39.95	46.61
Totals,	7,107.44	21.15	1,008.74	360.10	420.12

Silage Ration.

Blanche,	1,009.62	24.01	115.79	50.99	59.49
Brighty,	790.06	18.81	123.88	50.25	58.63
Doliska,	909.17	21.65	114.28	34.55	40.31
Dora,	874.78	20.83	125.01	44.44	51.85
Daisy,	798.06	19.00	123.14	46.13	53.82
Linnie,	997.35	23.75	141.82	52.86	61.67
May,	836.97	19.93	126.55	46.28	53.99
Roda,	930.92	22.16	126.42	43.19	50.39
Totals,	7,146.93	21.27	1,026.89	368.69	430.15
Percentage gain of silage over bran ration.	0.5	-	1.7	2.2	-

The yields are slightly in favor of the silage ration, but the differences are so small as to have no particular significance. Had cows May and Doliska remained undisturbed during the experiment, this increased yield would have been more pronounced.

Average Composition of Herd Milk (Per Cent.).

Character of Ration.	Total Solids.	Fat.	Solids not Fat.
Wheat bran, ...	14.19	5.07	9.12
Silage, ...	14.37	5.16	9.21

While the results show that the silage ration produced milk a trifle richer in both fat and solids not fat, the slight difference is without any important signification.

Dry and Digestible Matter required to produce Milk and Milk Ingredients (Pounds).

Character of Ration.	Dry Matter.			Digestible Matter.		
	One Hundred Pounds Milk.	One Pound Solids.	One Pound Fat.	One Hundred Pounds Milk.	One Pound Solids.	One Pound Fat.
Wheat bran, ...	111.35	7.85	21.98	65.84	4.64	13.00
Silage, ...	104.96	7.31	20.35	65.33	4.55	12.67

While the results show that in case of the silage ration it required a little less *dry matter* to produce a definite quantity of milk and butter fat, they also show that in case of both rations practically the *same quantity of digestible matter* was necessary to produce an equal quantity of milk products.

Food Cost of Milk Products.

Character of Ration.	Total Milk.	One Hundred Pounds Milk.	One Quart Milk (Cents).[1]	One Pound Butter (Cents)
Wheat bran, ...	$77 76	$1 09	2.45	18.5
Silage, ...	75 42	1 06	2.38	17.5
Percentage increased cost of bran over silage ration.	3.1	2.8	2.9	5.8

[1] 2.25 pounds is the commercial figure allowed for one quart of milk; the theoretical quantity is 2.15 pounds, the excess of .10 of a pound being allowed for loss in handling.

With hay at $15 a ton, silage at $3.50, bran at $22, corn meal at $24, cotton-seed meal at $28 and middlings at $26, the silage ration produced milk and butter slightly cheaper than did the bran ration. This difference in cost is due partly to the temporary variation in the cost of the several grains, and partly to the slightly more favorable effect of the silage ration.

Approximate Fertilizer Ingredients in Rations (Cost).

Wheat Bran Ration.

172.29 pounds nitrogen, valued at	$30 15
134.92 pounds potash, valued at	5 40
68.04 pounds phosphoric acid, valued at . .	2 72
Total, ...	$38 27

Silage Ration.

169.99 pounds nitrogen, valued at	$29 69
119.77 pounds potash, valued at	4 79
54.88 pounds phosphoric acid, valued at . .	2 20
Total, ...	$36 68

The total rations consumed by the herd contained nearly the same quantity of plant food. There was a slight excess of potash and phosphoric acid in the bran ration, due to the richness of the bran in these two mineral constituents.

Conclusions.

1. The silage ration produced slightly more milk and milk ingredients at a trifle less cost than did the bran ration.

2. A little less dry and digestible matter was required to produce a given quantity of milk products with the former ration.

3. Two animals were temporarily out of condition while receiving the silage ration. This may have been partly due to the effects of the heavy concentrates and partly to other causes.

Discussion of Results.

1. In both experiments hay and corn silage served as the roughage, while a mixture of cotton-seed meal, flour middlings and bran, or cotton-seed meal, flour middlings and

corn meal or corn and cob meal, served as the two grain rations; bran acted as a diluter of the heavy concentrates in one case, and corn silage in the other.

2. In the first experiment the results were slightly favorable to the bran ration, while in the second experiment the conditions were reversed. The differences were so trifling that it may be said that for practical purposes both rations produced equally satisfactory results.

3. As a practical deduction, the writer would suggest that farmers who keep comparatively small herds, and who personally look after the feeding, may reduce the quantity of *purchased grain* to 3 or 4 pounds daily per head, and substitute home-grown corn in place of wheat bran. Five to 7 pounds of grain daily is the usual allowance for cows producing about 10 quarts of milk of average quality. This grain mixture may consist of 1½ pounds of cotton-seed meal, 2 pounds of flour middlings and 2½ to 3 pounds of corn or corn and cob meal daily; or 1½ pounds of cotton-seed meal, 2 pounds of oat middlings or rye feed and 2½ to 3 pounds of corn meal. Malt sprouts may be substituted for the wheat, oat or rye middlings. The several grains after being mixed should be distributed through the silage or cut hay with the aid of a fork. This method of feeding will enable the farmer to get along with a minimum *cash outlay* for grain (4½ cents daily), and at the same time he will be supplying a well-balanced ration, rich in elements of fertility. The method will be more particularly suited to farmers not having easy transportation facilities, and who sell their dairy products to the creamery.

4. Farmers and dairymen who cannot closely supervise the feeding, and who desire to feed more than 5 to 7 pounds of grain daily, will probably find it advisable to use one-third to one-half wheat bran in compounding the grain mixture. Distillers' grains and malt sprouts have also been shown to be quite satisfactory distributers of the heavy concentrates.[1]

---

[1] Bulletin No. 94 of this station.

REPORT OF THE BOTANIST.

G. E. STONE; ASSISTANT, N. F. MONAHAN.

The long period of dry weather during the past summer has rendered many plants free from certain types of fungous diseases. On the other hand, the dry conditions were favorable for the outbreak of other troubles. A considerable amount of rain fell, and a more or less prolonged period of cloudy and damp weather prevailed during the latter part of August and first of September, which brought on some severe cases of blight. This rainy and damp period, coming as it did after the severe drought, exerted a peculiar influence on the quality of fruit, and in some instances it was responsible for inducing a renewed activity of the reproductive organs of plants. It is well known that favorable conditions following a check often stimulate vital activity along the lines of reproduction, and it was not surprising to find some wild plants responding in this manner.

Downy Mildew of Tomato.

(*Phytophthora infestans*, DBy.)

The damp and rainy period following the prolonged dry season caused an unusual outbreak on tomato plants, namely, the downy mildew, which is the same as that giving rise to the late blight of potatoes. It is seldom that this mildew attacks tomatoes, in this State at least, to any extent; but this season the damage was quite severe and widely disseminated, especially injuring the younger vegetative portions of the plants.

Potato Rot.

(*Phytophthora infestans*, DBy.)

The fungus mentioned above was also responsible to a large extent for damage to potatoes, causing them to rot, especially those grown on moist land. During the early part of the season potatoes as a whole were remarkably free from blight, and not until the rainy and damp period came in September did they display any alarming troubles. In some instances quite a large percentage was destroyed by rot. The spraying of potatoes in this State has not met with that degree of success that it has in other New England States, one reason being that the early blight often occurs here quite disastrously, and obtains a foothold early in the season.

Spraying for this trouble should commence early in June, when the plants are about one-fourth grown, and continue until late in the season. Another factor underlying successful spraying is pressure; at least 50 pounds' pressure should be maintained by the pump, to secure the best results. Experiments at the college this year showed material gain in the quantity of potatoes secured from sprayed crops, as compared with those not sprayed.

Cucumber and Melon Blight.

The dry summer with its freedom from moisture proved favorable for cucumbers and melons, and these crops were not severely affected, at least previous to September, with either the downy mildew or anthracnose. During the past fall there has occurred considerable infection to greenhouse crops, especially those started early. For the last six or seven years the downy mildew (*Plasmopara Cubensis* (B. & C.) Humphrey) has occurred generally upon greenhouse cucumbers started early in the house, and occasionally the anthracnose (*Colletotrichum Lagenarium* (Pass.) Ell. & Hals.) appears in the fall, but we know of no instances where either of these blights has wintered in greenhouses. Both of these blights must therefore at present be considered as left over from summer. The anthracnose, however,

usually makes its appearance in the spring on greenhouse plants, and the mildew about the 15th of August on either outdoor or greenhouse crops. Both of these blights can be readily controlled in the greenhouse by judicious attention to cultural methods. Neither of them will survive if attention is given to light, ventilation and especially moisture. When the foliage is kept dry these fungi are unable to get a start. In case syringing is necessary to keep the red spider down, it should be done in the morning in bright sunlight, at which time the plants will dry out readily. In case these blights have attained some headway, the pipes should be painted with sulphur and oil. Beneficial results have been reported by different growers who have tried this method.

Sun Scald.

The general interest manifested in shade trees in this State is quite apparent from the large number of specimens sent us each year, and the amount of correspondence touching upon various matters concerning them. The number of cases of sun scald to shade trees the past summer was unprecedented. This was particularly noticeable in rock maples and white pines, although this same trouble occurred with many trees and shrubs to some extent. The sun scald on rock maples was unusually abundant, and more severe than usual. Some trees which were under our observation had as much as ninety per cent. of their foliage as dry and crisp as casted leaves. Some maple trees possess the peculiarity of having their leaves badly scorched each year, where other trees of the same species located near them are entirely free from this trouble.

As a result of the prolonged drought and the excessive heat during mid-summer, many rock maples developed foliage of a peculiar bronze color. There was also much premature fall coloring and defoliation on many trees. The cause of so much sun scald during the past summer was drought and dry winds.

Where fine specimens of lawn or roadside trees exist, every effort should be made to maintain them in the best

condition possible. A deep, rich, loamy soil, well supplied with organic matter, constitutes a good guarantee against sun scald.

Burning of Conifers and Evergreens.

The burning or drying up of leaves commonly seen on conifers and other evergreens in spring is the result of winter or spring injury. Trees affected in this manner show the burning generally on one side, which coincides with the direction of some prevailing wind or storm. This is a genuine scald, similar to that prevailing on other trees, and occurs at a time when the ground is frozen and drying winds prevail. This is usually brought about by a sudden rise of temperature in the early spring when the plants are in frozen ground, at which time transpiration is active. Under these conditions root absorption is limited, whether the soil is moist or dry, and burning results.

An arbor vitæ hedge, which has been under our observation for some years, located on high ground with a severe exposure, becomes burned more or less every year. Frequently the burning is on the southeast side and occasionally on the southwest, but more often on the northwest, which is the direction of the prevailing winds.

There is a considerable amount of burning to conifers and rhododendrons in this State, and not infrequently this is so bad that the specimens are ruined. Much of this injury occurred during the winter of 1904–05, on evergreens located on private estates and in nurseries. One nurseryman states, for example, that all his evergreens, which included various species of abies, buxus, chamæcyparis, juniperus, picea, pseudotsuga, taxus, thuya and tsuga, burned last winter, and other nurserymen have experienced trouble with retinosporas and varieties of thuya or arbor vitæ.

Our native conifers are seldom injured in this manner except when transplanted in some uncongenial place, or where the environment is more or less modified. Swamp cedar burns frequently when taken from the swamp and

grown in ordinary soil, and the arbor vitæ, sparingly found as a native in this State, frequently burns when planted on high or more or less dry land with severe exposure. This holds good also for hemlocks, and to a certain extent for pines and junipers.

Winter-killing.

The disastrous effects of winter-killing are probably more discernible in the State at the present time than for many years; at least, we have no recollection of seeing so much damage done to so large a variety of trees and shrubs as has occurred in the last two or three years. The winter of 1903–04 was extremely severe on most of the native and exotic plants, including trees, shrubs and vines; and, while the winter of 1904–05 was not so severe in many ways, the past summer has done much to emphasize any trouble that was present to a slight degree before. The winter of 1902–03 was also a severe one, although the effects of killing during that period were largely above ground.

The symptoms of winter-killing are tolerably well marked in most instances, especially to the trained observer, and it is seldom that it need be confounded with anything else, neither is it always necessary to make extensive examinations of root systems to ascertain root killing. Furthermore, because a plant is native constitutes no evidence of its ability to withstand unusually severe conditions, since unusual seasonal peculiarities often render them less hardy. For example, the Labrador tea, which is a native of Labrador, has been known to winter-kill in this State, although the climatic conditions of this State are decidedly milder than those of Labrador. There are several classes of winter injury which may readily be distinguished, some of which are not unusual, and can be found every year. There is killing of that portion of the plant above ground as well as killing of the root systems, the latter being extremely common during the winter of 1903–04. Besides these types of injury mentioned above, there frequently occur frost cracks, twig killing, bud injuries, blisters to leaves, etc. The latter has occurred occasionally in leaves of apple trees in the spring

when they were tender, and frequently results in almost complete defoliation of apple trees during August. This trouble has been studied by Sorauer in Germany, by Stewart in New York, and by Stone and Smith in this State.

Some of the conditions which underlie winter-killing are as follows: —

Severe cold, causing frost to penetrate to a great depth.

Sudden and severe cold following a prolonged warm spell in the fall, in which case the wood tissue is tender and immature.

Conditions which favor a soft growth and immaturity of wood. Various causes may be responsible for this, such as growth in a low, moist soil, too heavy manuring or fertilization, or absence of sufficient sunlight.

General low vitality, caused by insect pests and fungous diseases and lack of moisture in the soil.

Insufficient soil covering, such as lack of organic matter, light mulching and snow covering in winter.

Location in unusually windy and exposed places, etc.

Species with a limited maximum range for cold are especially susceptible. There are innumerable examples at hand which will furnish illustrations of the various causes of winter-killing. For example, low vitality is well illustrated by the large number of old apple trees which have died in the last two years. The old, neglected orchards were the worst sufferers from the effects of winter-killing, and many isolated trees, such as cherry trees that had received no care for some years, were badly affected.

In one instance a number of peach trees and various kinds of shrubbery, both native and exotic, were severely injured where located near an overflow from a cesspool, while similar shrubbery near by was not injured in the least. This injury was due to the more rapid and tender growth of those plants which received benefit from the cesspool overflow. Perfectly hardy native plants, being deprived of a normal amount of light or grown in too dry places, are winter-killed readily; and Japanese maples on high, dry ground with severe exposure are extremely subject to winter-killing.

By far the most noticeable effects of winter-killing have

occurred above ground. This in some cases has resulted in local injuries to the trunk or in the loss of a few limbs, which has been responsible for completely ruining the symmetry of many valuable specimens, while in other instances many plants have died back to the ground. Some of the plants which have been affected in this way are as follows: Japanese maples, sycamore and Norway maples, apple, peach, plum, cherry, quince, grape vines, Japanese clematis, matrimony vine, roses, Forsythias, California privet, Amorpha fruticosa, Callicarpa purpurea and Americana, Ampelopsis tricuspidata, Deutzia scabra and gracilis, Diervilla florida-candida, Catalpa bungei, Exochorda grandiflora, Hibiscus syriacus, Magnolia tripetala, Lonicera japonica-halliana, Stephanandra flexuosa, Viburnum tomentosum, Tamarix tetrandra, Rhus semialata and Æsculus pavia.

Among the native plants may be mentioned the pine, ash, oak, white birch, alder, spice bush and holly. We observed large clumps of white birch and alders winter-killed above ground. The winter-killing of branches and twigs often occurs on young Japanese maples, especially where exposure is severe or when not given the best cultural conditions; and the young twigs of Norway and sycamore maples and horse-chestnuts have been quite susceptible to winter-killing of late. The killing of the buds and wood occurred in forsythias, peach and roses. Much of this winter-killing of branches, etc., is generally followed by an outbreak of Nectria cinnabarina and Schizophyllum.

As previously stated, the winter of 1903–04 was extremely severe in the amount of root killing which took place. The trees showing injury were the apple, pear, peach, quince, cherry, plum, white pine, red and rock maples, butternut, ash, oak and elm. Among shrubs, vines, etc., were the grape, raspberry and blackberry.

Many of the exotic ornamental plants suffered in the same way, such as, for example, the deutzias, California privet, etc.; in fact, many of the native and exotic species showed killing both above and below ground. The trees which have shown root killing the worst are apples, red maples, butternuts and pines. The effects of the winter-killing of

roots manifest themselves in many ways. Sometimes the plant is killed outright, while in other instances only a slight injury is caused. Many maples, for example, were killed outright, while others lost only a certain per cent. of their roots, thus causing thin tops, and where this injury was not very extensive many of the thin-top trees recovered in one year.

In some instances the leaves at the top of the red maple remained in a half-developed condition throughout the summer. In such cases the leaves were rather pale in color, and they assumed a peculiar pendulent position on the branches. These trees have also for the past two years manifested a premature autumnal coloration, especially on those portions with poorly developed foliage, the result of a limited water supply caused by winter-killing of the roots.

Apple trees were affected to a large extent by root killing, and many hundreds of them have succumbed. In many cases these trees would have been saved if severe pruning had been practised at the time of the first appearance of this trouble, since severe pruning of the tops of the trees would have balanced the root and branch systems. Peach, plum and quince trees were affected in the same way, but the trouble was not nearly so general with these. The same holds true for blackberries, raspberries and grapes. One of the peculiarities displayed by many of these plants consisted in their leaving out and bearing fruit, then suddenly collapsing.

The white pine was the most extensively affected tree. These trees in some localities were so severely affected that many of them died during the spring following the winter of 1903–04. In some severe cases the trunks were frozen and badly injured, but in the greater majority of cases the tips of the new leaves became brown and died. The dry summer of 1905 was severely trying for these partially affected pines. Had a normal water supply been available, this injury would not have resulted. The specimens which we examined had a large percentage of the small, fibrous roots killed, but in no case observed had the large roots been injured. This pine injury extends throughout the

whole State, but appears to be less common in the Connecticut valley than elsewhere.

One of the most distinctive features connected with the pine during the past summer was the burning of the tips of the leaves. In most cases the young, new leaves commenced to turn yellow at their ends, as if sun scorched, but usually grew worse; and in many instances all the needles turned yellow, subsequently died and dropped off. This might not occur on the whole tree, but on only one or more branches. Occasionally this trouble would occur before the young needles reached their normal length; and in such cases the needles would be short and the tree would present a stunted foliage, as we sometimes see on pines grown in very dry soil. Many were inclined to believe that some fungous disease was affecting the pines. Our examinations of the young needles in early summer showed no indications of fungi being present, and others have reported the same results. Subsequently, however, there appeared various species of fungi on the leaves, and in some cases on the branches, etc. This was merely a natural result following the weakened condition of the tree, caused by the affected root system.

Mrs. Flora W. Patterson of the Department of Agriculture in Washington, who had exceptional opportunities to examine the pine trouble as it occurred in New England and elsewhere during the summer, reports at least six different species of fungi upon the needles and branches. From examination of considerable material gathered in this State she has reported having found Phoma Harknessii, Sacc., Septoria parasitica, Hartig, Hendersonia foliicala, Berk. The Septoria was found in connection with the leaves that had their tips burned, and the Hendersonia was associated with a general yellowing or irregular spotting of the needles, while the Phoma was found with a quite different and by no means common trouble, causing no serious injury to the trees.

In conclusion, we would state that the trouble affecting the pine in this State was due primarily to the extreme winter-killing of the roots during the winter of 1903–04,

together with the unusually severe drought occurring in the summer of 1905. The occurrence of so many different fungi on the pine, which especially predominated during the late summer and fall, was very largely a secondary result of the weakened condition of the tree caused by winter-killing.

Relation between Soil Aeration and Germination and Growth.

For some time our attention has been given to the relation existing between seed germination and plant development, and soil texture and aeration. This problem possesses a practical bearing, inasmuch as it underlies the question of soil selection for specific crops. It is not our purpose at present to go extensively into this subject, but only to touch upon one phase of it. It is well known to gardeners and others that aeration, or the presence of air in soils, plays quite an important role in the development of seedlings. This experiment was made to determine what effects forcing air through soil would have upon germination and growth. For this purpose we made use of loam placed in two boxes, 18 by 18 by 18 inches. In each box there was a round funnel, 4½ inches in diameter, buried under the soil 1½ inches from the surface. Both funnels were connected with block tin tubes leading outside of the box, one of which was attached for a period of six hours each day to a water blower, and the other remained unconnected. Lettuce seed, which is quite susceptible to aeration, was employed, and 1,500 seeds were placed in each box, and the necessary data pertaining to germination, etc., were noted.

Table showing Results of Aeration on Growth of Lettuce Seedlings. 1,500 Seeds in Each Box.

	Number of Plants obtained.	Weight of Seedlings (Grams).		Average Gain in Weight (Per Cent.).
		Total.	Average.	
Unaerated,	977	83	.0847	-
Aerated,	1,210	152	.1239	46.27

From the preceding table it will be noted that there was considerable more seed germinated in the aerated box than in the unaerated one, as noted by the number of plants obtained; and that the average weight of the seedlings in the aerated exceeded those in the unaerated by 46 per cent. The seeds in the aerated box showed decided acceleration in germination, there being a difference of at least thirty-six hours in favor of the aerated seed. This experiment lasted from October 5 to November 8, and the difference in the size of the plants became more marked each day. In the aerated box the plants were noticeably larger over the funnel, while in the unaerated box the plants were largest near the edges of the box, where the soil had shrunk away from the sides, which enabled the roots of the seedlings to have free access to air.

That oxygen plays an important part in the germination of lettuce seed is quite evident from many experiments we have made with this species. The mere fact of covering lettuce seed loosely or sifting fine loam on them results frequently in enormous differences in the germination. Such seeds as lettuce and white clover are particularly susceptible to aeration; and, according to our numerous experiments, these seeds germinate best in soils of loose texture.

Comparison of Sterilized Loam and Subsoil.

Some experiments were conducted two years ago by Mr. S. R. Parker, then a senior specialist in the agricultural department of the college, which necessitated using a sterilized soil. In all of Mr. Parker's cultures, which were made in a soil very poor in organic matter, there was an extremely poor and sickly growth of soy bean in those pots which had been sterilized, whereas the growth was good in pots which had not been steamed. The experiments were carried on in our greenhouse, and the results were so different from those occurring in sterilized loam that it was considered wise to repeat them.

A soil similar to this had previously been sterilized for the growth of tobacco seedlings, without producing similar disastrous effects upon the plants. In the single experiment

given here we made use of a similar soil, namely, a yellow subsoil loam, containing little organic matter. Eight pots were selected, four of which contained loam and four subsoil. Of these, two each of the loam and subsoil pots were sterilized, and two each of the remaining pots were left unsterilized. The results follow.

Table showing Growth of Soy Bean in Sterilized and Unsterilized Loam and Subsoil.

	Total Number of Pots used.	Average Length (cm.) of Stems in —		Gain (+) or Loss (—) in Sterilized Soil (Per Cent.).
		Unsterilized Soil.	Sterilized Soil.	
Loam, ...	4	9.53	10.87	+14.05
Subsoil, ...	4	9.79	4.14	—57.70

The number of seeds germinated in unsterilized loam and soil was 30, that for the sterilized 34, showing a slight gain in favor of sterilization, which is unimportant, considering the small number of seeds used. There is also a gain in height of loam plants of 14 per cent. in favor of sterilization, while in the subsoil series there is a loss of 57 per cent. due to treatment. The subsoil pots also showed a poor, sickly development. This corresponded in every way with the results obtained by Mr. Parker in his experiments. This experiment shows, among other things, that extreme precaution is necessary in drawing deductions from experiments in which the soil is sterilized, especially where inoculation work is undertaken in connection with soil organisms.

Influence of Soil Sterilization on Seed Germination.

In a previous report [1] the results of a similar series of experiments were described, and this paper is a continuation of the earlier one. As in the preceding series, the seeds selected were in most cases from an old lot, which possessed a rather low germinating capacity. The object of these experiments was to ascertain the degree of acceleration in germination which would result from plant seed in steril-

[1] Fifteenth annual report of the Hatch Experiment Station, p. 41, 1903.

ized soil. Results of a similar nature have been observed by us a number of times in an incidental way when utilizing sterilized soils in our general experimental work in the greenhouse. The seeds were planted in boxes 18 by 12 by 3 inches, and previous to planting the soil in the sterilized boxes was heated by steam to a temperature of about 212° F. for one hour. The soil used constituted a good typical loam, characteristic of this region, and the sterilized and unsterilized soils were identical in every way except as to steaming. Other conditions, such as heat, light, degree of moisture, etc., were made the same as far as practicable. In Nos. 15 to 23, inclusive, 600 seeds were used in three separate experiments, where 100 seeds were sown in sterilized soil and 100 in unsterilized soil. In Nos. 25 to 34, inclusive, 800 seeds each were employed, there being two experiments. No. 39 is the result of only one experi-

Table showing the Germination of Seeds in Sterilized and Unsterilized Soil.

Laboratory Number.	Kind of Seed.	Total Number of Seeds tested.	Number Germinated in — Sterilized Soil.	Number Germinated in — Unsterilized Soil.	Per Cent. gained.
15,	Turnip,	600	159	54	35.00
16,	Radish,	600	148	101	15.66
17,	Onion,	600	148	94	18.00
18,	Red clover,	600	236	203	11.00
19,	Lettuce,	600	289	267	7.33
20,	Musk melon,	600	-	-	-
21,	Lettuce,	600	208	51	52.33
22,	Tomato,	600	79	63	5.33
23,	Crimson clover,	600	15	4	3.66
25,	Melilotus,	800	133	109	5.75
26,	Spinach,	800	378	246	33.00
27,	Peppergrass,	800	233	106	31.75
29,	Japanese millet,	800	-	-	-
32,	White mustard,	800	242	65	44.25
33,	White carrot,	800	-	-	-
34,	Winter vetch,	800	30	8	5.50
39,	Soy bean,	1,000	365	175	38.00
Average,		-	-	-	21.89

ment, this being made in the greenhouse bench soil; 500 seeds were sown in unsterilized soil and 500 in sterilized soil.

The data given in the table show that there occurred a positive gain in germination of the seed sown in sterilized soil. Nos. 20, 29 and 33, however, were old seed, which had apparently lost their power of germinating, and the stimulating effect induced by soil sterilization evidently had no effect on them. There is no reason for believing that when seeds have once lost their germinating power, or, in other words, are dead, this process will revive them. The percentage gained in some instances is quite marked, while in others it is insignificant. The average obtained from this series is 21 per cent. On account of the low germinating capacity prevailing here in many instances, the percentage gained is only indicative, since it would be necessary to employ a larger number of seeds to obtain more accurate averages. It should be pointed out, however, that better results than those given in these experiments have been observed many times in connection with lettuce, cucumber, melon seed, etc., in the greenhouse, where seed was used on a much larger scale. The degree of acceleration in germination is also marked, a feature which has been frequently noticed by us before. The number of seeds germinated during the first few days of these experiments, including Nos. 15 to 34, inclusive, was 169 for the sterilized soil and 146 for the normal loam, or a gain of 14 per cent. in favor of the sterilized soil. In the former series of experiments, previously noted, we obtained 25 per cent. of acceleration at the end of four days. There undoubtedly exists a difference in seeds in their response to stimulation in sterilized soils. Tomatoes, for example, respond but little if any to this method of treatment. The cause of this variation in different species of seeds is not known. Experiments are now being made along different lines which may throw some light on this question. The benefit to be derived from sowing seed in sterilized soil, both from a physiological and pathological point of view, is important enough to warrant in many instances its practice.

Influence of Soil Decoctions on Seed Germination.

Some attempt has been made in the following experiments to ascertain the cause underlying the effects which sterilized soil has on seed germination. The question has often arisen, In what manner does soil sterilizing affect seed germination? Is the cause underlying this form of stimulation a mechanical one, or a chemical one? In all probability both mechanical and chemical factors play a role here. If, however, the stimulus is of a chemical nature (and such types of stimulation are common enough to seeds), we would expect some response to occur on the part of the seeds when treated with decoctions of sterilized soils. For special reasons we therefore selected two types of soils, one of which was a typical Amherst loam, fairly rich in organic matter and suitable for greenhouse culture; the other soil a yellow loam of the nature of an Amherst subsoil, deficient in nitrogen and containing only a slight amount of organic matter. Three sets of experiments were carried out with each soil. In each set there was a boiled loam and subsoil, a sterilized loam and subsoil, and a normal loam and subsoil. The boiling and sterilizing lasted fifteen minutes, the latter being mostly done in an autoclave, under fifteen pounds pressure and at a temperature of 250° F. In all cases 400 grams of soil were employed. The soils were placed in percolators, with 500 c.c. of distilled water, and allowed to stand for twelve hours and to percolate very slowly. Four hundred grams of normal loam and subsoil, that is, soil that is not treated, were percolated in the same manner as the others. In addition to the above tests, tap water cultures were employed as checks, and run parallel in every way to the others.

In some instances, however, distilled water was used, besides the tap water, but since no difference existed between them, the distilled water tests were discontinued. After a percolate had been obtained for the various soils, the seeds were soaked in them for six hours, and then placed in germinators of the Zurich type, or into germinators composed of flower pot saucers provided with filter paper. In one or two instances the soy bean was germinated in sawdust.

Table I. — *Showing the Influence of Soil Decoctions upon Germination of Seeds immersed for Six Hours in Decoctions made by percolating 500 c.c. of Water through 400 Grams of Soil; 800 Seeds used in Each Treatment, except with the Soy Bean, where only 700 were used, making a Total of 21,700 Seeds.*

Seed.	Percentage of Germination in —						
	Tap Water.	Normal Loam.	Normal Subsoil.	Boiled Loam.	Boiled Subsoil.	Sterilized Loam.	Sterilized Subsoil.
Soy bean,	28.3	25.5	33.0	33.9	31.9	18.6	32.6
Buckwheat,	59.8	72.0	70.7	69.5	70.8	53.5	73.1
Radish,	52.7	51.7	53.1	51.8	56.7	48.5	52.3
Lettuce,	70.2	82.3	71.8	80.7	77.6	71.6	61.8
Average,	52.7	57.8	57.1	58.9	60.0	48.0	54.9
Total average,	52.7	57.4		59.4		51.5	

The preceding table shows the results obtained from experiments in which 21,700 seeds were employed. Since a large number of seeds were used in these experiments, quite accurate averages were obtained, and the factors due to variation are eliminated to a large extent. There is apparently a slight gain due to treatment shown in these experiments. The best average results were given by the boiled subsoil and loam, followed by the normal, while the sterilized loam is below the tap water seeds. By noting carefully the results obtained in these experiments, together with the nature and color of the decoctions, we surmised that the decoctions were too strong for the best results, consequently they were diluted with water to one-half strength in the next experiment.

TABLE II. — *Showing the Influence of Soil Decoctions upon Germination of Seeds immersed for Six Hours in Decoctions made by percolating 500 c.c. of Water through 400 Grams of Soil, diluted to Half Strength; 600 Seeds used in Each Treatment, making a Total of 16,800 Seeds.*

Seed.	Percentage of Germination in —						
	Tap Water.	Normal Loam.	Normal Subsoil.	Boiled Loam.	Boiled Subsoil.	Sterilized Loam.	Sterilized Subsoil.
Soy bean, . . .	50.0	50.2	51.0	55.5	53.5	55.2	51.7
Buckwheat, . .	77.2	70.5	81.2	82.5	83.5	72.5	73.0
Radish, . . .	48.0	53.2	48.0	59.7	53.0	60.5	58.5
Lettuce, . . .	82.2	83.7	87.2	78.0	73.7	74.0	80.8
Average, . .	61.3	64.4	66.8	68.9	65.9	65.5	66.0
Total average,	64.3	65.6		67.4		65.7	

These experiments are similar to the previous ones, except that half-strength decoctions were used in all cases. The results obtained from these three experiments are remarkably uniform in character, the tap water giving practically the same results as the decoctions.

TABLE III. — *Showing the Influence of Soil Decoctions upon Germination of Seeds immersed for Six Hours in Decoctions made by percolating 500 c.c. of Water through 400 Grams of Soil, diluted to One-fourth Strength; 600 Seeds used with Radish and Buckwheat, 400 Seeds with Lettuce and Soy Bean, making a Total of 14,000 Seeds.*

Seed.	Percentage of Germination in —						
	Tap Water.	Normal Loam.	Normal Subsoil.	Boiled Loam.	Boiled Subsoil.	Sterilized Loam.	Sterilized Subsoil.
Soy bean, .	84.0	74.5	89.5	73.0	83.5	77.5	84.0
Buckwheat, . .	66.5	91.7	85.0	93.7	91.7	82.7	83.7
Radish, . . .	65.5	64.5	62.5	46.5	50.0	55.5	56.5
Lettuce, . . .	74.5	72.7	72.7	63.7	70.7	65.2	69.5
Average, . .	72.6	75.8	77.4	69.2	73.9	70.2	73.4
Total average,	72.6	76.6		71.5		71.8	

In the experiment with the one-fourth strength decoctions, 14,000 seeds were employed, representing three experi-

ments. There is a slight increase shown in this series, due to treatment, which is the most marked in the normal loam and subsoil.

TABLE IV. — *Showing the Influence of Soil Decoctions upon Germination of Seeds immersed for Six Hours in Decoctions made by percolating 500 c.c. of Water through 400 Grams of Soil, diluted to One-eighth Strength; 200 Seeds used in Each Treatment, making a Total of 5,600 Seeds.*

SEED.	Percentage of Germination in —						
	Tap Water.	Normal Loam.	Normal Subsoil.	Boiled Loam.	Boiled Subsoil.	Sterilized Loam.	Sterilized Subsoil.
Soy bean,	75.5	75.0	75.5	85.5	85.0	87.0	80.5
Buckwheat,	66.5	82.0	83.0	84.5	81.5	78.5	83.5
Radish,	55.0	70.0	69.0	77.5	81.5	78.5	72.0
Lettuce,	70.0	68.5	74.5	98.9	73.0	77.0	79.5
Average,	66.7	73.8	75.5	86.6	80.2	80.2	78.8
Total average,	66.7	74.6		83.4		79.4	

The experiment with one-eighth strength decoction shows a decided gain throughout in the treated seeds, the most marked being given by the boiled and sterilized loams and subsoil decoctions. No further dilutions were tried, but from a careful study of the results of these experiments we are inclined to the belief that if more dilute solutions were used an increased gain would occur, especially in the sterilized series, since the most highly colored decoctions were obtained from the sterilized soils and the next highest color from the boiled soils. It appears to us that the sterilized decoctions were too strong, even when diluted to one-eighth strength. Some variation in the strength of the decoctions is likely to occur as a result of different percolators, and the failure of the one-fourth and one-half strength to show more of an acceleration may be attributed to this cause.

The following table gives the number of seeds that germinated in the first twenty-four hours in the preceding experiments, including tables I., II., III. and IV., from which the degrees of acceleration and retardation due to treatment can be obtained.

TABLE V. — *Showing the Degree of Retardation and Acceleration in Germination of Seeds soaked for Six Hours in Decoctions of Different Strengths made by diluting 500 c.c. of Water which had percolated through 400 Grams of Soil treated as below.*

	Number of Seeds per Treatment.	Per Cent. germinated in Twenty-fours Hours in —						
		Tap Water.	Normal Loam.	Normal Subsoil.	Boiled Loam.	Boiled Subsoil.	Sterilized Loam.	Sterilized Subsoil.
Soy Bean.								
Full strength, . .	600	27.7	27.5	30.5	33.1	29.5	8.3	27.5
Half strength, . .	200	22.0	20.0	17.0	21.0	23.0	23.0	23.5
Buckwheat.								
Full strength, . .	600	56.0	70.1	73.6	63.1	66.6	33.8	70.8
Half strength, . .	400	55.0	41.2	57.5	57.2	31.7	36.7	46.2
Quarter strength, .	400	43.7	59.5	50.2	57.2	59.0	52.7	61.5
Eighth strength, .	200	58.5	70.0	66.0	78.0	74.5	62.0	62.5
Radish.								
Full strength, . .	800	36.7	27.0	29.8	30.5	37.5	16.6	32.0
Half strength, . .	400	28.0	37.5	30.2	41.7	37.5	43.0	32.2
Quarter strength, .	400	45.0	43.5	39.0	17.5	24.0	37.0	37.0
Eighth strength, .	200	32.5	61.5	61.5	68.0	73.0	69.5	61.0
Lettuce.								
Full strength, . .	800	37.5	35.8	39.3	34.5	41.5	37.3	35.1
Half strength, . .	400	59.0	72.5	63.2	74.0	46.0	50.2	70.7
Quarter strength, .	400	67.0	52.0	55.7	44.5	51.5	53.5	56.5
Eighth strength, .	200	51.0	55.0	55.0	83.0	52.0	72.0	61.5
Average, . .	-	41.8	45.3	44.7	47.3	43.7	39.1	45.9
Average normal and total treated.	-	41.8	45.0		45.5		42.5	
		41.8	44.3					

This table gives the results of germination during the first twenty-four hours of 42,000 seeds, and the degree of acceleration obtained corresponds in a general way with the total number germinated as given in the preceding tables; or, in other words, the relationship between acceleration and the total number of seeds germinated is similar. Comparing the average number of seeds germinated during the first twenty-four hours by the various treatments with tap water, there are no important differences shown. On the whole,

however, there is a gain or acceleration due to treatment, the maximum acceleration being shown by the boiled loam.

A comparison of the different strengths of solutions shows that the one-eighth dilution produced the best results of any of the treatments, that for boiled loam being the highest. This series of experiments shows that decoctions of soils variously treated induce acceleration in seed germination, and that a larger number of seeds germinated in decoctions than in tap water. This increase is quite marked in dilute decoctions (one-eighth strength), and would probably be increased to some extent if the dilution should be carried still further. In these experiments we have a chemical explanation for the cause underlying acceleration and increased germinating capacity in sterilized soils. Undoubtedly driving out the gases and the subsequent absorption and renewal of fresh oxygen in sterilizing practices acts beneficially to soil and induces the seeds to germinate more quickly, as is shown by the aerating experiments previously reported. By the process of aeration, or by soaking seeds in dilute decoctions, many seeds germinate that otherwise would not; but there is no ground for belief that any of these stimulating processes actually revive or rejuvenate worthless seeds to a greater extent than would result from the most favorable conditions for germination.

Sterilized subsoil, or that lacking in humus, has the same effect on germination as sterilized loam rich in organic matter; but it inhibits growth to a very large extent, thereby differing in this respect. It would appear, therefore, that a considerable amount of humus is necessary in soils, in order that they may be materially benefited by sterilization.

The reason that bacteria multiply more and plants grow much more luxuriantly in sterilized soils is undoubtedly due to the fact that a larger amount of available material for plant development is present. Why subsoils and those poor in organic matter give rise to a greatly inhibited growth is not so clear at present, and we are not prepared to offer any explanation of this phenomenon.

Seed Selection.

It is a well-known fact that heavy, well-developed seeds produce more vigorous and more productive plants than lighter seeds of the same variety. This is altogether a reasonable statement, because the heavy, well-filled seed has the more perfect embryo, and also has the larger supply of plant food on which to support the seedling until the plant is capable of getting its nourishment from the air and soil.

With such crops as wheat, rye and the grasses, the selection of seed is not of so very great importance, because usually an overabundance of seeds is planted, and sufficient seeds develop so that in the natural struggle for existence in their overcrowded state the weaker and less vigorous plants are crowded out and only the more vigorous and healthy plants reach maturity; and this number which reaches maturity represents the maximum number of plants that can be developed under existing conditions, so that nothing in the crop is lost by this crowding out of the weaker plants. On the other hand, with greenhouse, market gardening and general field or what is known as hoed crops, the conditions are entirely different. In this case each plant has its full share of light, heat and space, and a poor, weakly plant is just so much loss, not only because it occupies a space that ought to produce a well-developed plant, but also because a number of undersized, weakly plants in a crop detracts from the market value of the crop as a whole, and also because weak plants are more subject to disease, and act as a breeding-place for diseases that may infect the whole crop; therefore, the careful selection of seed becomes an important factor in growing plants. In the case of large seeds, such as corn, this selection is comparatively an easy matter. An ear of corn of the desired type, having kernels of a desirable size and shape and of full development, may be picked out, and by discarding the poor, undeveloped seeds at either end the rest of the seeds may be utilized for planting. Here knowledge of the type of seed and judgment only may be relied upon. Beans, peas, etc., may be selected in much the same way, with reasonable assurance that the best results will be

obtained. In the case of such seeds as lettuce, turnip, cabbage, tobacco and other small seeds this method of separation is not practicable, and other methods have to be resorted to.

From early times the separation of seeds by means of water has been practised to a considerable extent. In this case the seed is placed in a quantity of water, well shaken and let stand a few minutes, then the seeds which do not sink are removed, and only those that have sunk used for planting.

The results of some of our experiments with this method of separation are given in the tables following.

TABLE I. — *Showing the Results of Germination with Onion and Lettuce Seed separated by the Water Method; 400 Seeds used in Each, or a Total of 1,600.*

Seed.	Per Cent. germinated of — Light.	Per Cent. germinated of — Heavy.	Per Cent. Increase of Germination of Heavy over Light.
Onion, ...	38.0	85.0	142.5
Onion, ...	50.0	58.5	17.0
Onion, ...	44.0	88.0	100.0
Lettuce, ...	68.0	90.0	32.3

TABLE II. — *Showing the Results of Seed Germination and Growth of Onion Seedlings separated by Water; 200 Seeds in Each Lot, or a Total of 400 used.*

Onion.	Per Cent. of Germination.	Number of Plants.	Weight of Plants (Grams). Total.	Weight of Plants (Grams). Average.	Average Per Cent. gained of Heavy over Light.
Heavy (sunk), ...	42.5	85	18.1	.213	37.42
Light (floated), ...	19.5	38	5.9	.155	-

This method, however, is not entirely satisfactory, because many of the heavier seeds are buoyed up by air bubbles and therefore thrown away, and in our work we have noticed that a few of the undersized seeds also go to the bottom.

Many investigators[1] have carried this process still farther, and separated their seeds by what is known as the specific gravity method. In this case solutions of salt (sodium chloride), ammonium nitrate, sodium nitrate, potassium nitrate and calcium chloride have been used. For this purpose solutions of different specific gravities have been made, in which the seeds were placed, first in that solution with the highest specific gravity. The seeds which floated in this solution were skimmed off and placed in that of the next highest specific gravity, and so on. It has been found that by this method seeds of the same variety, of a uniform, sound condition, differ in specific gravities only within a very narrow range. This, however, does not seem to be a very practical plan, as it involves the making of solutions of tested specific gravity and quite a little mechanical manipulation. Another method, known as the specific gravity sampling method, is perhaps of less value, as in this case one lot of seed is compared with others in bulk, without separating the poor and undeveloped seeds. It amounts simply to the choosing of the best lot from several samples of seeds.

The separation of seeds by sieves would seem to be the easiest and most practical way, and this method with us has given very good results. We used a series of four sieves, having round perforations of 2 mm., 1.5 mm., 1 mm., and .05 mm. respectively. Ten grams of seed were weighed out and run through this series of sieves, with the following results: —

TABLE III. — *Showing the Results of sifting Seeds, in which 10 Grams were employed.*

Number of Sieve.	Size of Seed.	Weight in 10 Grams of Seed (Grams).	Per Cent.
No. 1, ...	2.0–1.5 mm.	1.015	10.15
No. 2, ...	1.5–1.0 mm.	6.689	66.88
No. 3, ...	1.0– .5 mm.	1.800	18.00
No. 4, ...	.5– .0 mm.	0.491	4.91

[1] Among whom may be noted V. A. Clarke, New York (Geneva) Experiment Station, Bulletin No. 256.

Five hundred seeds were then counted out from each of these four grades or sizes of seeds, with the exception of No. 4 (.5–.0 mm.), which was composed entirely of chaff, dirt, etc. These were sown in flats and allowed to grow for four weeks, when the seedlings were taken up, counted and weighed, with the following results: —

TABLE IV. — *Showing the Results of Germination and Growth of Seedlings from Three Experiments with Sifted Lettuce Seed; 1,500 Seeds used in Each Experiment, making a Total of 4,500 Seeds employed.*

SIZE OF SEED.	Per Cent. germinated.	Number of Seedlings.	WEIGHT OF SEEDLINGS (GRAMS).		Average Per Cent. gained in Weight of Large over Small Seedlings.
			Total.	Average.	
2.0–1.5 mm., . . .	56.7	672	317.5	.518	98.42
1.5–1.0 mm., . . .	53.5	642	293.7	.457	75.09
1.0– .5 mm., . . .	40.4	485	126.3	.261	–

From this table it will be seen that of the large 16.3 per cent. and of the medium 13.1 per cent. more seeds germinated than of the small seeds, and that the four-weeks-old seedlings from the large seed averaged 98.42 per cent. and those from the medium seed 75.09 per cent. heavier than those from the small seed. It will also be noticed that the differences in the per cent. of germination and the weight of seedlings from the large and medium seeds were not very great; but the difference between the germination, and especially in the weight of seedlings of the larger and small seeds, is very marked.

We are of the opinion that it would pay a grower to separate his lettuce seed with a sieve having a mesh of one millimeter in diameter (1/25 inches), and to use only such seed as did not pass through a sieve of this size. From these plants he could make a further selection, as is customary at the time of transplanting. This would result in saving considerable ground space which is valuable, and not only would a more vigorous and uniform setting of lettuce be obtained, but the treatment would also eliminate many weak and undesirable plants, which are more likely to be sus-

ceptible to disease. In other words, much of the selection would be done more cheaply and easily by sifting the seed than as it is done at the present time, by selection in the seed bed. A sieve of the size mentioned can easily be made by purchasing from almost any tin shop a piece of colander tin of 1 millimeter mesh, which can very readily be soldered to a suitable rim, or even fastened to a tomato can which has had the bottom removed.

Our experiments in sifting seed have been confined, however, for the most part to lettuce seed; and, while these seeds can be separated in this way very easily, much more difficulty would be experienced in separating some other types of seed, such as turnip or tobacco; and another objection to this method is that the size and weight of seeds do not necessarily correspond, that is to say, a large seed may not necessarily be a heavy one. When seeds are separated by sifting, while the largest size contains practically all of the heaviest seeds and the lighter seed is practically all in the small sizes, there will be a few light seeds in the larger size and a few heavy seeds in the smaller sizes, so that this method by no means gives an absolute division of the seeds by weight, which is the ideal method of seed selection.

Mr. A. D. Shamel of the Connecticut (New Haven) Experiment Station uses a very satisfactory method for the separation of tobacco seed, which we can do no better than describe in his own words: —

This seed separator consists of a glass tube 1 inch in diameter and 5 feet long, and a glass receptacle for holding the seeds, having the diameter of the long glass tube, and so arranged with a finely woven wire screen in the bottom as to hold the seeds in the receptacle, and at the same time freely admit a current of air directly into the seed. The top of this receptacle is fitted with a coupling into which the long glass tube can be set and held in place. The current of air is developed by a common foot bellows and regulated with a valve. The seed to be separated is poured into the receptacle, usually about 1 to 2 ounces at a time, the glass tube set in place and a current of air pumped into the seed. The lightest seed and chaff are first blown out of the tube, and next the small seed. Small

seed of the same character as the larger seed have proportionally more surface than the larger, consequently the small as well as the light seed is removed by this machine.

This seems to be the most satisfactory way of separating seed that has yet been devised, and no doubt some simple, inexpensive instrument modelled from this device will soon be available for every farmer and seed grower. The particular advantages of this method seem to be that this device is adaptable to all kinds of small seeds, the only adjustment needed being in the regulation of the amount or force of air sent through, and that by this method the seed is separated according to weight.

In conclusion, we believe it desirable with many kinds of garden seeds to separate the seed and discard all except the large, well-developed, mature and heavy seed, because: —

First. — About 33 per cent. of seeds as placed on the market consist of dirt, chaff, and small, undesirable seeds.

Second. — Small or light seeds do not germinate well, and their seeds produce only poor, small, undesirable plants, which prove inferior in every way.

Third. — Heavy seeds produce healthy, large, well-developed plants, that will give maximum crops.

Fourth. — Seed selection or separation is an inexpensive process that gives good results.

Asparagus Rust.

The past summer in most parts of Massachusetts has been an extremely dry one, and especially favorable, as was early anticipated, to an early and severe attack of asparagus rust. The confinement of the rust, or at least its injurious stage, to special localities has been the same this season as in other years; in other words, it has been confined to soils especially coarse, and easily affected by drought.

Since 1896 there have been about three severe outbreaks of the rust in this State, such outbreaks being identified with a dry summer, or at least with seasons where there have existed long periods between rainfalls. The fall or teleuto stage, however, has been present every year since

1896, and it has always been widely distributed. Any bed which has become once infected with this stage remains so, but fortunately the damage occurring from teleutospore infection is insignificant, and in the majority of cases not discernible. Asparagus rust has now become quite well distributed over the United States, but its virulence does not show itself in the same degree for every locality, and the problem of control is by no means everywhere the same, since factors enter into the problem which do not possess the same significance for all locations. In this State rust is most intimately associated with lack of vigor, and more particularly with those factors which underlie vigor, such as supply of water and judicious fertilizing. For this reason the most efficient remedies are based upon those practices the application of which induce vigor. There are a number of remedies which can be applied, some of which have given excellent results. Thorough cultivation and fertilization in more than one instance have given results which have proved superior to any other method of treatment. We have observed that the results from weekly cultivation combined with judicious fertilization have proved very satisfactory. Irrigation has also proved very effectual during dry seasons; but there is possibly a tendency for asparagus to become too succulent with repeated irrigation, which might possibly render the plant more susceptible to infection.

We also believe that an efficient practice pertaining to rust infection consists of burning the old brush in the fall, since a large number of teleutospores are destroyed, which, if left remaining in the ground over winter, would germinate freely in the spring and constitute a dangerous source of infection. We have repeatedly attempted to germinate teleutospores in the early winter, but failed. They will germinate freely in March, however. Moreover, the roots from infested plants, when transplanted in the greenhouse in the fall and left there for a year and allowed to develop tops, have never shown any tendency to rust. This would seem to indicate that not only is a resting period essential, as is usually the case for spores, but freezing also is essential. We are of the opinion that most beds are infected in

this State by teleutospores during the spring and summer, and that the mycelium works up through the stem; and if the conditions for the plant are unfavorable, pustules bearing uredospores will break out in July or August, whereas, if the conditions for the plant are favorable, pustules bearing teleutospores will make their appearance during September or later.

In case uredospores break out in the plant during July and August, other beds in the vicinity, if in suitable condition, will invariably become infected. If, however, the crop is in a vigorous condition, even if located close by, it will resist the outbreak of the rust. This, indeed, has occurred many times in beds side by side, although of different age and vigor, and in the case of those beds more or less remote it may be stated that there are hundreds which have never had any uredo outbreak.

We observed a young bed of asparagus the past summer, about two years old, which had never been cut, and which had a teleutospore outbreak early in July. This bed suffered much from drought, and was not in an especially vigorous condition. It was, however, located on soil of fine texture, intermingled with coarse pebbles. There was little inclination for the plants of this bed to grow worse, notwithstanding the fact that drought prevailed, and it remained in practically the same condition all summer. On dry soil this never occurs, since it is the uredo stage that makes its appearance in these soils in July and August; and plants infected with this stage turn brown in a short time after they become infected. Moreover, the teleutospore outbreak occurring in summer is a perfectly harmless factor, as far as immediate infecting of the bed is concerned. Our studies of the rust problem have shown that there is an intimate connection existing between the texture and water contents of soils and uredospore outbreaks, and a series of water determinations of different soils during the season would probably bring out some interesting facts.

Spraying with Bordeaux mixture has not proved satisfactory in this State as a means of controlling the rust, and little or no use is now made of it for this purpose.

Some reports have been made concerning the use of the

sulphur wash spray recommended by Prof. R. E. Smith, formerly of this station. This mixture, which consists of sulphur, soap, potash and water, possesses remarkable sticking qualities, and it is undoubtedly the most efficient mixture recommended for spraying for asparagus rust.

An Application of the Copper Sulfate Treatment.

Early in the summer the college pond became so overrun with Algæ as to be unsightly, and the smell of this decaying vegetable matter was so unpleasant that it became necessary to treat it.

Microscopic examinations of the water showed that it contained a considerable amount of short suspended filaments, of a slightly whitish or greenish color, which proved to be *Anabæna flos-aquæ*, a form of Algæ found frequently in public water supplies, and which gives rise to considerable trouble. The water content of the pond was roughly determined, and then treated with 1 part of copper sulfate to 4,000,000 parts of water. The required amount of copper sulfate was placed in a loosely woven sack and hung over the stern of a canoe, which was paddled around the pond in concentric circles for about one-half an hour, when all the copper sulfate was dissolved. This is the method recommended by Drs. Moore and Kellerman in their work on treating reservoirs with copper sulfate. A careful examination of samples taken twenty-four hours after treatment showed a slight decrease in *Anabæna*, and in two or three days it had practically disappeared.

Spirogyra, which was present along the shores near the inlet at the time of treatment, was not affected, and subsequently a number of large clumps were found in a flourishing condition in different parts of the pond, and many forms of Algæ, such as *Desmids* and *Diatoms*, appeared not to be in the least affected by the treatment. Neither did the animal life seem to be affected in any way by the treatment, as no ill effects could be noted on the fish, frogs, tadpoles or other fauna inhabiting the water.

Of the *Protozoa*, the *Ceratium* was very numerous both before and after treatment, and was in no wise affected by

the copper. *Daphna*, a form of Crustacea, was also plentiful, and experienced no ill effects from the copper treatment.

From day to day the bacterial contents of the water were determined, with the results shown in the following table: —

Copper Sulfate Test on Massachusetts Agricultural College Pond Water.

Date of taking Sample.	Number of Bacteria per Cubic Centimeter of Water.
1905.	
June 17 (one hour after treatment),	6,224
June 19,	3,463
June 20,	219
June 21,	336
June 22,	1,583
June 23,	1,187
June 24,	538
June 25,	1,144
June 26,	1,399
June 27,	1,144
June 28,	616
June 29,	763
June 30,	1,145
July 1,	1,078
July 3,	1,078
Sept. 16,	990
Sept. 17,	1,017
Sept. 18,	990
Sept. 19,	636

From this table it will be seen that the bacteria decreased very rapidly for the first few days after treatment, and, while they slowly increased again, they never reached their former numbers. The results obtained on June 24, 28 and 29 may be attributed to an unusually clear or settled state of the water on those days, while when the other samples were taken the water was considerably agitated, either from the effects of rain or wind.

A second treatment was contemplated in September for the

purpose of studying the effects of copper sulfate on bacteria; but as the bacteria showed no appreciable increase at this time, we thought it not worth while to inaugurate another experiment. Samples of water taken one hour and twenty-four hours after treatment were tested for copper by the foods and feeding department of the station; and, while possible traces of the copper were found, they were so small and uncertain that no copper could be reported. In these tests the ferrocyanide method was employed, which in numerous other cases has failed to give reliable results where such small quantities of copper are present.

At the time these chemical tests were being made for copper there came to our notice a test described and recommended by Dr. Ewerts,[1] which claimed to detect one part of copper in 30,000,000 parts of water. This test is based on the inhibiting action of copper to diastatic action. This method was given a trial in the foods and feeding chemical laboratory, and found to be unsatisfactory. Quite likely, however, a detailed study of this latter method, together with some practice, will prove it to be of some value.

The result of this single experiment with copper sulfate in treating the college reservoir is not sufficient in itself to allow deductions of great value. They corroborate, however, the experiments made by Messrs. Moore and Kellerman on the Belchertown reservoir, and those made elsewhere, in showing that *Anabaena* is extremely susceptible to copper, and can readily be killed by this method of treatment. Moreover, the general clearing up and rapid disappearance of odor from the water two or three days after treatment, together with the falling off of bacteria, was quite noticeable. It should be stated, however, that there was a fall of about 20° in the temperature on the third day after treatment, which would have a tendency to affect *Anabaena*; and about one and one-half inches of rain fell between the 19th and 24th of June.

---

[1] Ztschr. Pflanzenkrank, Bd. XIV., 3 Heft., p. 133.

A Comparison of the Numbers of Bacteria in Sterilized and Unsterilized Soils.

BY A. VINCENT OSMUN.

There has been repeated inquiry as to the effect sterilization of soil has upon its bacterial flora. In the absence of any reliable experiments touching upon this question, it has frequently been assumed that by soil sterilization the bacteria, and especially the beneficial ones, are destroyed, hence injuring the soil. In regard to this question, it may be stated that little is known about either the so-called beneficial or injurious bacteria of greenhouse soils; and, in consequence of a paucity of knowledge upon this phase of the subject, positive statements are out of place. From what is already known about the effects of soil sterilization upon plant growth and the changes which such soil undergoes, it might be assumed upon *a priori* grounds that soil bacteria would be found to exist more abundantly in sterilized soil than in unsterilized soil. Moreover, it must be borne in mind that absolute sterilization is never accomplished, but something more closely approaching pasteurization takes place. All bacteria are by no means killed, as has been shown by various tests made at this station.[1] Subjecting soils to steam heat has a marked stimulating effect on the growth of plants. Observations at this station and experience of growers have shown this to be true. Just why this treatment of soil should stimulate the growth of plants is not known. Sorauer[2] suggests that steam heat makes the humus compounds more available to plants. It is not unlikely that steam flowing through a soil also improves its mechanical condition.

The stimulating effect of soil sterilization on plant growth suggested a similar effect on the bacterical content of soil so treated; and in order to obtain more evidence regarding this point this experiment was planned: —

Two boxes about 20 inches square and 9 inches deep and of equal weights were filled to the depth of about 5 inches

[1] Hatch Experiment Station, Massachusetts Report, 1902, pp. 77, 78.

[2] Sorauer, The Physiology of Plants, pp. 45, 46.

with equal amounts by weight of soil from the supply bin of the station greenhouse. Before filling the boxes a quantity of soil from the bin was thoroughly mixed, and the boxes filled from that, so that the soils in the two boxes were as nearly alike as possible. The soil in one box was treated for half an hour with flowing steam applied through perforated tubes buried beneath the surface; the soil in the other box was untreated. One week after sterilization a sample was taken from each box for the determination of the numbers of bacteria in the soil, after which the boxes were placed on a platform scale and brought to equal weights with water. Water was similarly applied every day during the experiment, and the soil always contained from 17 to 20 per cent. moisture. Samples for the determination of the quantitative bacterial content of these soils were taken at intervals of about two weeks. The soil was frequently stirred, and at the times of sampling the entire contents of each box were thoroughly mixed and pulverized.

The results of this experiment are tabulated in the accompanying table: —

Showing the Relative Number of Bacteria in Sterilized and Unsterilized Loam.

Date of taking Sample.	Number of Bacteria per Gram of Dry Soil.	
	Sterilized.	Unsterilized.
1905.		
April 3,	6,712,000	56,273,000
April 18,	64,526,000	39,080,000
May 1,	66,089,000	31,372,000
May 16,	29,963,000	8,029,000
June 1,	26,666,000	14,631,000

The figures in this table show that steam flowing through soil for half an hour not only does not kill all the bacteria in that soil, but that it seems to act as a stimulus, causing rapid mutiplication of numbers. Practically all vegetative forms would be killed, but most spores would be uninjured, and, given favorable conditions after treating, would germinate. One week after sterilization the treated soil contained

nearly 7,000,000 bacteria per gram. This number is probably considerably in excess of the number in the same soil immediately after sterilization, but it indicates that treating soil with live steam at about 210° F. for half an hour does not kill all the bacteria in that soil. The untreated soil contained a good number of bacteria at the beginning, — about 56,000,000.

During the four weeks immediately after the first samples were taken there was a phenomenal increase in the number of bacteria in the sterilized soil. From 7,000,000 per gram at the beginning the number had advanced to nearly 65,000,000 at the end of two weeks, and after four weeks to over 66,000,000. On the other hand, the number in the untreated soil showed a steady decrease, for which no cause is at present apparent.

After six weeks the numbers of bacteria in both sterilized and unsterilized soils had dropped way below the numbers found at the end of four weeks. During the next two weeks the sterilized soil continued to drop off, though not to any great extent, while the unsterilized soil advanced.

At this point it became necessary to discontinue the taking of samples because of the press of other work.

We are unable to account for the decrease in numbers of bacteria in either sterilized or unsterilized soil. A similar decrease in numbers of bacteria has been noted in other experiments in the greenhouse in which unsterilized soil was used. The temporary increase in numbers in the sterilized soil may be attributed to the stimulus given by the steam heat; and it appears also that sterilization had a tendency to overcome, for a time at least, the antagonistic agency or agencies which caused the decrease in the unsterilized soil.

More extended experiments and observations are necessary before definite conclusions can be reached regarding the effect of so-called sterilization on the bacterial contents of soils; but from the results obtained in this experiment and from tests of other soils, both sterilized and unsterilized, we may conclude that steam treatment of soils greatly stimulates bacterial development in them, and that if certain as yet unknown adverse conditions can be removed, the high numbers may be retained indefinitely.

REPORT OF THE ENTOMOLOGISTS.

C. H. FERNALD, H. T. FERNALD.

The year 1905 has been marked by a great abundance of insects of many kinds, while the two years preceding were equally marked by their scarcity. To this fact is probably due the large increase in the amount of correspondence the present year, nearly two thousand letters having been sent out, besides an unrecorded amount of printed matter, in answer to questions received.

Investigations as to the number of broods and times of appearance of the codling moth and oyster-shell scale have been continued during the season, and should be repeated for several years to come, that reliable date averages may be obtained, and thus the best times for the treatment of these insects be ascertained.

Several private insecticides have been more or less tested and the results noted, statements of these having been supplied in each case to the persons sending the materials. While some of these substances were shown to have a certain value for the destruction of insects, it was noticeable that they were no more effective than well-known insecticides costing less, or that they were injurious to the foliage of the plants they were tested on. In fact, none of the materials tested at this station during the year can be considered as adding anything of value to our present list of standard insecticides, though it has taken considerable time from other work to establish these negative results.

The collections of the division have, as usual, been given the needed care and have been added quite considerably to during the year, while additional facts as to the distribution of insect pests in Massachusetts and their habits have been

gathered and recorded. The card catalogue has been kept abreast of the new publications and improved in many ways, and requests for the information it contains are frequently received from other stations and from individuals.

Some study has been given to the carnation twitter, and the identity of the insect causing this trouble has been ascertained with considerable though not absolute certainty. Further investigations on this subject will be made during the coming year if material to study can be obtained.

Special researches have also been continued on the Asilidæ or robber flies; the Pyralidæ, a group including many very injurious insects; the Bombinæ or bumble bees and their habits; and on the Sphecidæ or digger wasps, these studies being of the entire groups; while a Cecidomyiid on oak, the stalk borer and several other species have received special attention individually.

The erection of a new greenhouse during the summer has greatly improved the facilities of the division for entomological research, besides being an excellent example of modern greenhouse construction. With a house which is reasonably tight and which can be kept warm during the winter it has been possible to begin a series of experiments to determine the resistant power of various forcing crops to fumigation. The business of raising crops under glass in Massachusetts is a very large one, and in too many places is greatly interfered with by the presence of insects which can only be controlled by fumigation with hydrocyanic acid gas. The strength of fumigation necessary to destroy these insects is now well known in most cases, but the charge which the plants can resist under all conditions of growth is not; and many an owner has refused to fumigate a badly infested house for fear of killing his plants along with the insects. From the experiments now under way, and which it will require several years to complete, it is believed that data can be obtained of such a nature that any person who desires to treat a greenhouse will be able to do so with entire safety to the plants, and yet kill the insects which may be present.

Insects of the Year.

The present year has been favorable for the rapid increase of insects in Massachusetts, and, though no one species has been present in overwhelming abundance, each has done its part in attacking crops of all kinds.

The San José scale is as abundant as it has ever been in the State, and is spreading farther each year. Where its presence is neglected it makes itself speedily felt; but with the methods we now have for its control there is no reason why it should be more than a nuisance in the future, requiring treatment every two or three years, like any of our other pests.

Cutworms and wire worms have given much trouble, particularly in the eastern and central portions of the State, while but little has been heard of root maggots this season.

The army worm has caused considerable injury locally on some of the cranberry bogs and elsewhere in southeastern Massachusetts, and in the central and western parts of the State the moths of this pest have been more abundant than for some time. It has now been nearly ten years since the last outbreak of this insect, and it is not unlikely that another may be due before long, if unknown factors do not develop to prevent it.

Inquiries about insects have covered a wider range than usual, but the most numerous questions have been about several species of scale insects, plant lice of different kinds, red spiders, borers, datanas, the bean weevil and the red-humped apple-tree caterpillar.

Since the Legislature placed the work on the gypsy and brown-tail moths in the hands of a special commission, no particular attention has been given them here; but some facts observed in connection with their distribution are here noted, as they have been gathered by members of the station. A few tents of the brown-tail moth were observed in Amherst last spring and others were received from Martha's Vineyard, while several were found on Nantucket last fall, showing that this insect is widely distributed over the State. Several cases have also been reported to the station of the presence

of the gypsy moth outside of the territory originally occupied by it, and these observations have been confirmed by inspectors of the Gypsy Moth Commission. That this insect is now rapidly spreading there can be no doubt, and it is too probable that the entire State will before long be infested by these two insects, which are among the worst enemies to man which occur in the United States.

APPENDIX.

Compilation of Analyses of Agricultural Chemicals, Refuse Salts, Ashes, Lime Compounds, Refuse Substances, Guanos, Phosphates and Animal Excrements.

H. D. HASKINS.

1. Chemicals, refuse salts, etc.
2. Ashes, marls, lime compounds, etc.
3. Refuse substances.
4. Guanos, phosphates, etc.
5. Animal excrement, etc.
6. Average per cents. of the different ingredients found in the preceding compilation of analyses, calculated to pounds per ton of 2,000 pounds.

1868 to 1905.

This compilation does not include the analyses made of licensed fertilizers. They are to be found in the different bulletins and annual reports of the State inspector of fertilizers from 1873 to 1895, which are contained in the reports of the secretary of the Massachusetts State Board of Agriculture for these years, and in the bulletins of the division of chemistry of the Hatch Experiment Station of the Massachusetts Agricultural College since March, 1895.

No valuation is stated in this compilation, as the basis of valuation changes from year to year.

In the following compilation of analyses of agricultural chemicals, refuse materials, manurial substances, etc., the signification of the star (*) prefixed to the name of the substance is that the compilation is made up of analyses subsequent to the year 1897. It was believed that a compilation made up of more recent analyses would more nearly

represent the present general chemical character of the substances, and would therefore be of more practical value.

It must be understood that the chemical character of many of the refuse substances used for manurial purposes is constantly undergoing changes, due to frequent variations in the parent industry.

As a rule, in all succeeding analyses the essential constituents are determined and stated; blanks do not imply the absence of the non-essentials.

1. *Chemicals, Refuse Salts, etc.*

Fertilizer Materials.	Analyses.	Moisture.	Ash.	Nitrogen.			Potash.			Total Phosphoric Acid.			Soluble Phosphoric Acid.	Reverted Phosphoric Acid.	Insoluble Phosphoric Acid.	Sodium Oxide.	Calcium Oxide (Lime).	Magnesium Oxide.	Ferric and Aluminic Oxides.	Sulphuric Acid.	Carbonic Acid.	Chlorine.	Insoluble Matter.
				Maximum.	Minimum.	Average.	Maximum.	Minimum.	Average.	Maximum.	Minimum.	Average.											
*Carbonate of potash, high grade,	6	3.38	–	–	–	–	67.20	55.68	60.92	–	–	–	–	–	–	–	–	–	–	–	–	–	–
*Carbonate of potash and magnesia,	2	18.22	–	–	–	–	20.00	18.48	19.24	–	–	–	–	–	–	–	–	19.52	–	–	–	–	.39
Carnalite,	1	–	–	–	–	–	–	–	13.68	–	–	–	–	–	–	7.66	–	13.19	–	.56	–	41.56	–
*Kainit,	9	2.18	–	–	–	–	13.65	10.90	12.47	–	–	–	–	–	–	18.97	2.37	6.37	–	20.25	–	20.61	2.13
Krugite,	1	4.82	–		–	–	–	–	8.42	–	–	–	–	–	–	5.27	12.45	8.79	–	31.94	–	6.63	14.96
*Muriate of potash,	70	1.56	–	–	–	–	54.80	45.40	49.89	–	–	–	–	–	–	6.69	–	.55	–	–	–	48.80	.70
*Nitrate of potash,	5	.98	–	14.58	11.60	13.30	45.62	43.88	44.57	–	–	–	–	–	–	–	–	–	–	–	–	–	–
*Nitrate of soda,	93	1.52	–	16.57	14.14	15.47	–	–	–	–	–	–	–	–	–	35.50	–	–	–	–	–	.50	.50
*Nitre lime,	2	.92	–	–	–	8.42	–	–	–	–	–	–	–	–	–	–	29.30	–	–	–	–	–	2.28
Nitre salt cake,	2	6.03	–	–	–	2.29	–	–	.87	–	–	–	–	–	–	29.56	–	–	–	47.77	–	–	3.92
Phosphate of potash,	1	3.76	–	–	–	–	–	–	32.55	–	–	37.50	–	37.50	–	–	–	–	–	13.43	–	–	.92
Phosphate of ammonia,	1	6.05	–	–	–	10.37	–	–	–	–	–	43.86	–	–	–	–	–	–	–	12.46	–	–	.82
*Refuse from manufacture of cyanide of potash,	1	39.23	–	–	–	.96	–	–	7.36	–	–	–	–	–	–	–	–	–	–	–	–	–	–
*Sulfate of ammonia,	23	.99	–	22.16	19.44	20.74	–	–	–	–	–	–	–	–	–	–	–	–	–	60.00	–	–	–
*Sulfate of potash, high grade,	48	.82	–	–	–	–	53.15	45.70	49.25	–	–	–	–	–	–	1.46	–	1.50	–	15.72	–	–	.75
*Sulfate of potash-magnesia,	24	3.83	–	–	–	–	31.68	19.55	25.34	–	–	–	–	–	–	6.25	2.57	13.86	–	44.72	–	1.95	2.26

1. *Chemicals, Refuse Salts, etc.* — Concluded.

Fertilizer Materials.	Analyses.	Moisture.	Ash.	Nitrogen. Maximum.	Nitrogen. Minimum.	Nitrogen. Average.	Potash. Maximum.	Potash. Minimum.	Potash. Average.	Total Phosphoric Acid. Maximum.	Total Phosphoric Acid. Minimum.	Total Phosphoric Acid. Average.	Soluble Phosphoric Acid.	Reverted Phosphoric Acid.	Insoluble Phosphoric Acid.	Sodium Oxide.	Calcium Oxide (Lime).	Magnesium Oxide.	Ferric and Aluminic Oxides.	Sulphuric Acid.	Carbonic Acid.	Chlorine.	Insoluble Matter.
* Silicate of potash,	4	7.86	-	-	-	-	27.62	21.48	20.59	-	-	-	-	-	-	-	-	-	-	-	-	-	-
* Sulfate of magnesia,	10	23.76	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2.82	17.40	-	36.10	-	-	5.73
* Sulfate of soda,	1	1.38	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	59.43	-	-	-
Saltpetre waste,	12	2.54	-	3.30	.52	2.22	30.94	1.55	13.66	-	-	-	-	-	-	37.04	.75	.19	-	1.85	-	46.25	-
* Vegetable potash,	6	3.63	-	-	-	-	27.84	23.96	25.95	-	-	2.55	-	-	-	-	20.65	-	-	-	-	-	9.70

2. *Ashes, Marls, Lime Compounds, etc.*

Fertilizer Materials.	Analyses.	Moisture.	Ash.	Nitrogen. Maximum.	Nitrogen. Minimum.	Nitrogen. Average.	Potash. Maximum.	Potash. Minimum.	Potash. Average.	Total Phosphoric Acid. Maximum.	Total Phosphoric Acid. Minimum.	Total Phosphoric Acid. Average.	Soluble Phosphoric Acid.	Reverted Phosphoric Acid.	Insoluble Phosphoric Acid.	Sodium Oxide.	Calcium Oxide (Lime).	Magnesium Oxide.	Ferric and Aluminic Oxides.	Sulphuric Acid.	Carbonic Acid.	Chlorine.	Insoluble Matter.
* Acetylene gas-tank refuse,	1	4.20	-	-	-	-	-	-	-	-	-	-	-	-	-	-	59.15	-	-	-	-	-	-
Ashes of spent tan bark,	5	4.84	-	-	-	-	2.87	.60	1.81	2.77	.13	1.36	-	-	-	-	31.11	3.39	1.78	-	-	-	25.21
Ashes from cremation of swill,	15	4.86	-	-	-	-	8.83	1.25	3.97	32.36	7.47	14.16	-	-	-	-	33.58	1.87	4.65	-	-	-	21.57
Ashes from blue works,	1	12.14	63.78	-	-	-	-	-	9.02	-	-	-	-	-	-	-	-	-	-	-	-	-	12.30
* Ashes from cremation of garbage,	3	3.01	-	-	-	-	6.01	3.72	5.13	10.21	7.16	8.77	-	-	-	15.65	20.22	1.16	9.22	4.57	10.85	4.75	28.42
* Ashes from hay and straw,	1	.40	-	-	-	-	-	-	1.55	-	-	1.02	-	-	-	-	5.22	-	-	-	-	-	66.35
* Ashes from jute waste,	1	.19	-	-	-	-	-	-	.51	-	-	.54	-	-	-	3.84	6.04	.39	7.60	-	-	.57	81.02
* Ashes from peach tree trimmings,	1	.54	-	-	-	-	-	-	4.92	-	-	2.44	-	-	-	7.53	18.74	-	10.50	2.20	-	-	13.54
* Ashes from soft coal and sawdust,	1	3.36	-	-	-	-	-	-	.73	-	-	.74	-	-	-	-	2.80	-	-	-	-	-	69.53

Ammoniated marl,	1	3.31	-	-	-	1.61	-	-	-	-	-	10.39	-	.41	9.98	-	-	-	-	-	-	-	-
* Bleachery refuse,	2	4.19	-	-	-	-	1.24	.35	.79	-	-	-	-	-	-	11.69	35.79	-	-	-	-	-	23.09
Bituminous coal ashes,	2	3.66	-	-	-	-	-	-	.38	-	-	.44	-	-	-	-	1.88	-	-	-	-	-	74.17
* Brick-yard ashes,	2	.58	-	-	-	-	3.59	3.32	3.45	1.61	1.33	1.47	-	-	-	-	24.33	-	-	-	-	-	47.63
* Coal and wood ashes,	1	1.32	-	-	-	-	-	-	.44	-	-	1.15	-	-	-	-	2.39	-	-	-	-	-	80.94
* Cotton-seed hull ashes,	33	7.31	-	-	-	-	32.80	14.08	22.53	15.53	6.26	8.49	-	6.88	1.28	-	7.03	12.64	-	7.31	-	-	17.12
* Corn-cob ashes,	2	5.47	-	-	-	1.18	42.38	7.08	24.73	7.08	2.37	4.72	-	-	-	-	7.00	-	-	-	-	-	38.12
* Carbonate of lime,	2	.45	-	-	-	-	-	-	-	-	-	-	-	-	-	-	52.31	-	-	-	-	-	-
Gypse,	1	1.64	-	-	-	-	-	-	-	-	-	-	-	-	-	-	50.87	-	-	-	-	-	2.87
* Gas-house lime,	5	11.16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	48.19	8.30	-	19.66	-	-	8.39
Green sand marl (Virginia),	1	1.25	-	-	-	-	-	-	1.14	-	-	9.37	-	-	-	-	25.78	-	5.13	-	-	-	41.32
* Hemp ashes,	1	-[1]	-	-	-	-	-	-	2.48	-	-	1.71	-	-	-	-	60.17	-	-	-	-	-	3.14
Hard-pine wood ashes,	1	.75	-	-	-	-	-	-	10.16	-	-	2.24	-	-	-	-	24.95	-	-	-	-	-	29.90
* Lime refuse from soda factory,	1	21.07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	14.86	-	1.36	23.11	-	-	1.63
Lime waste from sugar factory,	1	36.30	-	-	-	-	-	-	.22	-	-	2.25	-	-	-	-	27.51	-	-	-	-	-	.32
Lime,	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	93.63	-	-	-	-	-	1.33
* Lime-kiln ashes,	10	11.35	-	-	-	-	4.73	.43	2.04	1.58	.03	.78	-	-	-	-	41.49	1.30	-	-	-	-	6.78
* Leather-scrap ashes,	3	5.94	-	-	-	.15	3.36	1.00	2.23	3.96	1.80	2.89	-	-	-	-	7.80	-	-	-	-	-	16.08
Logwood ashes,	1	1.50	-	-	-	-	-	-	.08	-	-	2.30	-	-	-	-	3.90	-	-	-	-	-	9.70
Mill ashes,	1	.53	-	-	-	-	-	-	1.60	-	-	.46	-	-	-	-	34.93	1.35	-	-	-	-	36.36
Magnolia ashes (Florida),	1	1.58	-	-	-	-	-	-	2.56	-	-	.45	-	-	-	-	-	-	-			-	6.12
Massachusetts marls,	7	13.70	-	-	-	-	-	-	.21	2.72	.06	1.05	-	-	-	-	10.50	.61	.69		28.57		3.14

[1] None.

2. *Ashes, Marls, Lime Compounds, etc.* — Concluded.

Fertilizer Materials.	Analyses.	Moisture.	Ash.	Nitrogen.			Potash.			Total Phosphoric Acid.			Soluble Phosphoric Acid.	Reverted Phosphoric Acid.	Insoluble Phosphoric Acid.	Sodium Oxide.	Calcium Oxide (Lime).	Magnesium Oxide.	Ferric and Aluminic Oxides.	Sulphuric Acid.	Carbonic Acid.	Chlorine.	Insoluble Matter.
				Maximum.	Minimum.	Average.	Maximum.	Minimum.	Average.	Maximum.	Minimum.	Average.											
* Marl,	1	15.54	-	-	-	.01	-	-	.29	-	-	.02	-	-	-	-	-[1]	-	-	-	-	-	-
Marl (North Carolina),	1	.70	-	-	-	-	-	-	.04	-	-	.56	-	-	-	-	21.95	.61	-	-	-	-	50.18
* Nova Scotia plaster (gypsum),	17	6.45	-	-	-	-	-	-	-	-	-	-	-	-	-	-	33.74	.75	-	44.87	-	-	5.79
Olive earth (Virginia),	1	1.97	-	-	-	-	-	-	.24	-	-	13.73	-	-	-	-	19.16	-	6.00	-	-	-	50.55
Onondaga plaster (New York gypsum),	4	13.27	-	-	-	-	-	-	-	-	-	-	-	-	-	-	30.00	4.66	-	32.50	8.20	-	9.83
* Oyster-shell lime,	2	-[2]	-	-	-	-	-	-	-	-	-	.38	-	-	-	-	55.54	-	-	-	9.45	-	8.82
* Picker-waste ashes,	1	.28	-	-	-	-	-	-	6.56	-	-	1.18	-	-	-	-	-	-	-	-	-	-	63.43
* Patent-process lime,	1	-[2]	-	-	-	-	-	-	-	-	-	-	-	-	-	-	57.87	-	-	-	-	-	9.03
* Prepared lime,	1	-[2]	-	-	-	-	-	-	-	-	-	-	-	-	-	3.99	69.48	.50	1.50	-	-	-	-
* Pine-wood ashes,	1	2.76	-	-	-	-	-	-	4.37	-	-	3.07	-	-	-	-	23.61	-	-	-	-	-	37.46
* Peat,	5	45.30	20.47	1.88	.34	.92	-	-	.04	.11	-[1]	.08	-	-	-	-	.88	-	-	-	-	-	16.23
* Plastering,	1	7.20	-	-	-	-	-	-	-	-	-	.22	-	-	-	-	11.50	-	-	-	-	-	66.50
Peat ashes,	1	4.67	-	-	-	-	-	-	.46	-	-	.11	-	-	-	-	2.28	1.63	6.13	-	-	-	45.17
* Pulp ashes,	1	-[2]	-	-	-	-	-	-	.46	-	-	.12	-	-	-	-	67.72	-	-	-	-	-	7.00
Railroad-tie ashes,	1	4.70	-	-	-	-	-	-	.92	-	-	.56	-	-	-	-	2.51	-	-	-	-	-	80.20
* Refuse ashes from sawdust,	1	13.92	-	-	-	-	-	-	3.58	-	-	7.92	-	-	-	-	34.76	-	-	-	-	-	25.27

Sea-weed ashes,	1	1.47	-	-	-	-	-	-	.92	-	-	.30	-	-	-	8.76	6.06	4.37	-	2.98	-	6.60	68.65
* Tan-bark ashes,	1	1.50	-	-	-	-	-	-	.52	-	-	.77	-	-	-	-	24.20	-	-	-	-	-	13.54
* Wood ashes,	5.55	12.08	-	-	-	-	13.58	1.12	5.42	6.07	.06	1.42	-	-	-	-	32.98	3.31	7.43	-	-	-	16.51
* Wool-waste ashes,	1	8.40	-	-	-	-	-	-	27.24	-	-	.26	-	-	-	-	2.88	-	-	-	-	-	27.82
* Wood charcoal,	2	3.65	-	-	-	-	-	-	.40	-	-	.16	-	-	-	-	-	-	-	-	-	-	1.58
* Walnut-wood ashes,	1	3.79	-	-	-	-	-	-	5.06	-	-	2.07	-	-	-	-	40.73	-	-	-	-	-	2.29
* Waste lime from tannery,	2	.88	-	-	-	.65	-	-	-	-	-	-	-	-	-	-	54.78	-	-	-	-	-	2.83
* Waste lime,	1	.80	-	-	-	-	-	-	-	-	-	-	-	-	-	-	74.12	-	-	-	-	-	.38
Virginia marls,	2	15.98	-	-	-	-	.61	.37	.49	.09	.08	.09	-	-	-	-	7.25	.21	-	.66	7.25	-	64.23

3. *Refuse Substances.*

Ammoniate,	1	5.88	-	-	-	11.33	-	-	-	-	-	3.43	-	-	-	-	-	-	-	-	-	-	1.38
* Blood and bone,	5	5.97	-	7.19	5.70	6.23	-	-	-	12.86	11.38	12.11	-	4.41	7.73	-	-	-	-	-	-	-	-
* Bone dust,	1	5.06	-	-	-	3.06	-	-	-	-	-	17.80	-	7.24	10.56	-	-	-	-	-	-	-	-
Bone soup,	1	82.92	7.07	-	-	1.14	-	-	-	-	-	1.26	-	-	-	-	-	-	-	-	-	-	-
* Bone from fish,	1	8.78	-	-	-	4.82	-	-	-	-	-	23.54	-	8.01	15.50	-	-	-	-	-	-	-	-
* Broom-corn seed,	1	7.40	-	-	-	1.51	-	-	.50	-	-	.57	-	-	-	-	-	-	-	-	-	-	-
* Banana skins,	1	13.99	-	-	-	.24	-	-	5.46	-	-	1.80	-	-	-	-	-	-	-	-	-	-	-
Blue-green algæ (*Lyngbia Majasculus*),	1	16.26	-	-	-	1.25	-	-	.79	-	-	.19	-	-	-	3.53	2.06	1.18	-	-	-	-	5.53
* Burned bone,	5	2.06	-	-	-	-	-	-	-	-	-	37.33	-	2.71	35.66	-	52.12	-	-	-	-	-	.96
* Cocoanut-fibre pith,	1	6.20	3.78	-	-	.31	-	-	.84	-	-	.03	-	-	-	-	.57	-	-	-	-	-	1.01

1 Trace.

2 None.

3. *Refuse Substances* — Continued.

Fertilizer Materials.	Analyses.	Moisture.	Ash.	Nitrogen.			Potash.			Total Phosphoric Acid.			Soluble Phosphoric Acid.	Reverted Phosphoric Acid.	Insoluble Phosphoric Acid.	Sodium Oxide.	Calcium Oxide (Lime).	Magnesium Oxide.	Ferric and Aluminic Oxides.	Sulphuric Acid.	Carbonic Acid.	Chlorine.	Insoluble Matter.
				Maximum.	Minimum.	Average.	Maximum.	Minimum.	Average.	Maximum.	Minimum.	Average.											
*Cocoa shells,	1	3.88	–	–	–	2.33	–	–	2.48	–	–	.36	–	–	–	–	.76	–	–	–	–	–	–
*Concentrated wool washings,	1	41.13	–	–	–	1.09	–	–	10.15	–	–	.10	–	–	–	–	–	–	–	–	–	–	–
*Condensed bone steam,	1	81.75	–	–	–	1.94	–	–	–	–	–	.07	–	–	–	–	–	–	–	–	–	–	–
*Castor-bean pomace,	6	7.64	5.70	5.85	4.68	5.18	3.40	.64	1.20	2.26	1.57	2.12	–	–	–	–	.87	.29	–	–	–	–	1.75
*Cassava waste,	1	9.03	–	–	–	.33	–	–	.28	–	–	.06	–	–	–	–	.61	–	–	–	–	–	–
*Cotton-seed meal,	1.27	6.85	–	–	7.99	3.24	6.74	1.92	1.41	1.64	3.30	1.71	2.56	–	–	–	–	–	–	–	–	–	.28
*Cotton-seed dust,	1	4.38	–	–	–	1.22	–	–	1.48	–	–	.54	–	–	–	–	1.48	–	–	–	–	–	–
*Cotton-seed droppings,	1	4.08	–	–	–	.96	–	–	1.85	–	–	.20	–	–	–	–	.66	–	–	–	–	–	–
*Cotton compost,	1	42.51	–	–	–	–	.93	–	–	.56	–	–	.39	–	–	–	–	–	–	–	–	–	–
*Cotton waste, wet,	4	24.02	34.42	1.34	.84	1.21	.76	.43	.64	.74	.56	.65	–	–	–	–	2.73	–	–	–	–	–	38.16
*Cork dust,	1	.74	–	–	–	.59	–	–	.33	–	–	.10	–	–	–	–	.74	.08	–	–	–	–	.24
*Coral formation,	1	39.26	–	–	–	.28	–	–	.14	–	–	.21	–	–	–	–	23.14	1.39	–	–	–	–	16.98
*Cotton waste, dry,	9	6.45	13.57	1.60	.55	1.03	1.62	.48	1.13	.66	.08	.32	–	–	–	–	1.73	–	–	–	–	–	14.61
Cotton dust,	2	32.68	50.93	–	–	.78	–	–	.45	–	–	.32	–	–	–	–	–	–	–	–	–	–	42.22
*Dried blood,	34	10.45	6.37	13.55	7.99	10.16	–	–	–	8.70	.03	2.50	–	–	–	–	–	–	–	–	–	–	–
Dried soup from meat and bone,	1	14.80	8.40	–	–	9.97	–	–	–	–	–	.53	–	–	–	–	–	–	–	–	–	–	.64

Dried soup from rendering cattle feet,	1	10.80	7.50	-	-	14.47	-	-	-	-	-	.46	-	-	-	-	-	-	-	-	-	-	.26
* Dry ground fish,	59	8.87	-	10.48	6.06	8.36	-	-	-	16.07	5.50	8.87	-	4.64	4.18	-	-	-	-	-	-	-	-
* Damaged grain,	3	42.15	-	1.97	.84	1.44	.43	.16	.28	.83	.35	.55	-	-	-	-	-	-	-	-	-	-	-
* Deposit from Charles River,	1	21.46	-	-	-	.95	-	-	.59	-	-	.74	-	-	-	-	1.81	-	-	-	-	-	44.27
* Dredgings from Cape Cod,	1	18.99	-	-	-	.99	-	-	.13	-	-	.07	-	-	-	-	-	-	2.06	-	-	.54	-
* Deposit from pond,	1	4.01	-	-	-	.41	-	-	.26	-	-	.32	-	-	-	-	1.62	-	-	-	-	-	-
Eel grass,	2	35.39	15.60	.96	.70	.83	1.61	.21	.91	.41	.22	.32	-	-	-	1.63	2.13	.11	-	-	-	-	1.06
* Factory waste,	5	13.11	32.20	2.95	.47	1.55	11.78	.18	3.57	1.07	.29	.60	-	.24	-	-	13.02	-	-	6.73	-	-	6.14
Felt refuse,	1	29.24	33.53	-	-	5.26	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
* Fibre waste,	1	61.53	-	-	-	.22	-	-	.49	-	-	.10	-	-	-	-	.36	-	-	-	-	-	.53
* Fleshings,	1	6.96	43.14	-	-	7.55	-	-	-	-	-	.31	-	-	-	-	-	-	-	-	-	-	-
* Fresh-cut bone,	1	24.98	-	-	-	3.00	-	-	-	-	-	16.85	-	5.26	11.59	-	-	-	-	-	-	-	-
Fish with 20 to 40 per cent. water,	10	30.19	20.59	7.41	4.22	5.97	-	-	-	8.32	4.68	7.09	.74	2.69	3.64	-	-	-	-	-	-	-	1.68
Fish with more than 40 per cent. water,	10	45.46	15.50	7.60	2.43	4.97	-	-	-	8.56	2.94	5.08	1.17	1.33	2.58	-	-	-	-	-	-	-	1.35
Fresh-water mud,	1	40.37	-	-	-	1.37	-	-	.22	-	-	.26	-	-	-	-	1.27	.29	1.80	-	-	-	18.26
* Garbage tankage,	1	2.12	-	-	-	5.95	-	-	-	-	-	6.06	-	4.40	1.66	-	-	-	-	-	-	-	-
* German peat moss,	1	9.50	1.14	-	-	.72	-	-	.06	-	-	.05	-	-	-	-	.21	-	-	-	-	-	.36
* Ground tobacco stems,	8	8.84	20.20	2.72	.99	2.02	8.18	3.88	6.15	1.15	.32	.62	-	-	-	-	6.75	-	-	-	-	-	1.30
Ground bone, damaged by salt water,	1	32.81	-	-	-	1.78	-	-	-	-	-	17.21	-	5.26	11.95	-	-	-	-	-	-	-	-
* Ground bones,	2.53	5.03	66.11	5.94	.85	3.06	-	-	-	31.12	14.50	21.34	-	8.52	15.82	-	-	-	-	-	-	-	1.08
Glucose refuse,	1	8.10	-	-	-	2.62	-	-	.15	-	-	.29	-	-	-	-	.18	.02	-	-	-	-	.07
Horn shavings,	1	4.83	-	-	-	15.31	-	-	-	-	-	.42	-	-	-	-	-	-	-	-			

3. *Refuse Substances* — Continued.

Fertilizer Materials.	Analyses.	Moisture.	Ash.	Nitrogen.			Potash.			Total Phosphoric Acid.			Soluble Phosphoric Acid.	Reverted Phosphoric Acid.	Insoluble Phosphoric Acid.	Sodium Oxide.	Calcium Oxide (Lime).	Magnesium Oxide.	Ferric and Aluminic Oxides.	Sulphuric Acid.	Carbonic Acid.	Chlorine.	Insoluble Matter.
				Maximum.	Minimum.	Average.	Maximum.	Minimum.	Average.	Maximum.	Minimum.	Average.											
* Hoof meal,	1	4.10	-	-	-	15.19	-	-	-	-	-	.77	-	-	-	-	-	-	-	-	-	-	-
* Horn dust,	3	8.63	-	-	-	14.60	-	-	-	-	-	.04	-	-	-	-	-	-	-	-	-	-	-
Horn and hoof waste,	3	10.17	7.63	15.49	11.84	13.25	-	-	-	2.30	1.36	1.83	-	-	-	-	-	-	-	-	-	-	.24
* Hair waste,	1	6.52	22.77	-	-	9.22	-	-	.14	-	-	.51	-	-	-	4.10	-	-	-	-	-	-	-
* Hop refuse,	2	84.56	1.71	.69	.49	.59	.06	.05	.05	.11	.10	.10	-	-	-	-	-	-	-	-	-	-	.83
Ivory dust,	1	11.50	52.63	-	-	6.64	-	-	-	-	-	24.56	.97	17.97	5.62	-	-	-	-	-	-	-	-
* Jadoo fibre,	2	10.20	11.60	.97	.77	.87	.48	.38	.43	1.24	.26	.75	-	-	-	-	3.50	-	-	-	-	-	4.05
Jute waste,	1	13.10	-	-	-	1.50	-	-	.08	-	-	.72	-	-	-	-	-	-	-	-	-	-	-
* Kiln dust from brewery,	1	9.72	-	-	-	4.32	-	-	2.16	-	-	.96	-	-	-	-	.78	-	-	-	-	-	7.11
* Linseed meal,	7	8.65	-	6.42	5.26	5.78	1.58	1.46	1.52	1.59	1.36	1.47	-	-	-	-	-	-	-	-	-	-	.58
Lobster shells,	1	7.27	-	-	-	4.50	-	-	-	-	-	3.52	-	-	-	-	22.24	1.30	-	-	-	-	.27
* Meat meal,	1	3.22	8.55	-	-	9.23	-	-	-	-	-	3.08	-	-	-	-	-	-	-	-	-	-	-
Meat mass,	5	12.09	13.60	11.50	9.69	10.44	-	-	-	3.58	.56	2.07	-	-	-	-	-	-	-	-	-	-	.58
Meat scrap,	2	24.79	-	-	-	6.33	-	-	-	-	-	5.79	-	-	-	-	-	-	-	-	-	-	-
Morocco factory waste,	1	22.72	-	-	-	1.16	-	-	.36	-	-	2.56	-	-	-	-	19.60	-	-	1.24	-	-	24.17
* Meat and bone,	12	8.64	-	-	-	5.29	-	-	-	-	13.78	16.81	-	7.06	9.74	-	-	-	-	-	-	-	-

Mill sweepings,	1	9.49	-	-	-	3.76	-	-	.66	-	-	1.18	-	-	-	-	-	-	-	-	-	-	5.01
* Mill waste,	1	4.50	-	-	-	1.84	-	-	.58	-	-	1.07	-	-	-	-	-	-	-	-	-	-	-
Madder,	2	11.93	-	-	-	.91	-	-	2.40	-	-	.35	-	-	-	-	3.93	.51	-	-	-	-	4.67
* Milk cassein,	1	7.15	-	-	-	7.30	-	-	.76	-	-	8.06	-	-	-	-	11.78	-	1.40	-	-	-	.10
Mussel mud, wet,	1	60.01	27.29	-	-	.21	-	-	6.17	-	-	.10	-	-	-	.70	.93	.14	3.48	-	-	-	-
Mussel mud, dry,	1	2.24	72.02	-	-	.72	-	-	-	-	-	.35	-	-	-	-	23.39	-	8.26	-	-	-	37.60
* Muck and peat, wet,	28	67.58	9.97	1.35	.12	.46	.16	.02	.05	.19	.01	.06	-	-	-	-	.37	-	-	-	-	-	6.73
* Muck and peat, dry,	8	6.67	69.54	2.10	.26	.84	-	-	-	-	-	.31	-	-	-	-	.77	-	-	-	-	-	-
* Mud,	3	42.02	44.76	.65	.19	.35	-	-	.15	-	-	.02	-	-	-	-	.09	-	-	-	-	-	-
Oleomargarine refuse,	1	8.54	14.42	-	-	12.12	-	-	-	-	-	.88	-	-	-	-	-	-	-	-	-	-	.96
* Paper-mill dustings,	1	1.68	23.41	-	-	.35	-	-	.60	-	-	.13	-	-	-	-	.30	-	4.40	-	-	-	14.23
* Product from garbage plant,	1	4.14	-	-	-	2.56	-	-	.50	-	-	6.92	-	-	-	-	-	-	-	-	-	-	16.48
Pine barren grass,	1	8.48	2.40	-	-	.16	-	-	.07	-	-	.18	-	-	-	-	-	-	-	-	-	-	1.67
Pine needles,	1	9.48	3.42	-	-	.46	-	-	.03	-	-	.12	-	-	-	-	-	-	-	-	-	-	1.22
* Rawhide dust,	1	14.50	-	-	-	13.91	-	-	-	-	-	1.06	-	-	-	-	-	-	-	-	-	-	-
Raw wool,	1	6.95	7.54	-	-	12.88	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3.63
Rotten brewers' grain,	1	78.77	-	-	-	.72	-	-	.04	-	-	.43	-	-	-	-	.26	.15	-	-	-	-	.59
Refuse from calico works,	1	4.07	-	-	-	4.28	-	-	-	-	-	11.95	-	-	-	-	-	-	-	-	-	-	-
* Refuse from glucose factory,	1	.13	-	-	-	-	-	-	-	-	-	42.76	-	2.88	39.88	-	38.78	-	2.92	3.00	-	-	-
* Refuse from glass factory,	1	16.48	-	-	-	-	-	-	19.50	-	-	-	-	-	-	6.12	-	-	-	-	-	-	-
Residue from water filter,	1	94.22	-	-	-	.12	-	-	-	-	-	.05	-	-	-	-	-	-	-	-	-	-	-
Rockweed, green,	1	68.50	23.70	-	-	.62	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

3. *Refuse Substances* — Concluded.

Fertilizer Materials.	Analyses.	Moisture.	Ash.	Nitrogen.			Potash.			Total Phosphoric Acid.			Soluble Phosphoric Acid.	Reverted Phosphoric Acid.	Insoluble Phosphoric Acid.	Sodium Oxide.	Calcium Oxide (Lime).	Magnesium Oxide.	Ferric and Aluminic Oxides.	Sulphuric Acid.	Carbonic Acid.	Chlorine.	Insoluble Matter.
				Maximum.	Minimum.	Average.	Maximum.	Minimum.	Average.	Maximum.	Minimum.	Average.											
Rockweed, dry,	2	13.73	35.75	1.45	1.07	1.26	4.89	1.56	3.22	2.75	.14	1.44	–	–	–	5.97	4.88	.96	1.22	–	–	.16	–
* Salt marsh mud,	5	60.65	32.32	.28	.18	.24	–	–	.14	–	–	.08	–	–	–	–	.11	–	–	–	–	2.06	37.88
* Silt deposit,	1	7.15	–	–	–	1.14	–	–	.39	–	–	.25	–	–	–	–	.70	–	–	–	–	–	–
Sponge refuse,	1	7.25	–	–	–	2.43	–	–	–	–	–	3.19	–	–	–	–	3.94	1.27	–	–	–	–	39.05
* Sizing paste,	2	62.28	–	2.13	1.13	1.63	–	–	–	.34	.02	.18	–	–	–	–	–	–	–	–	–	–	–
* Sizing waste,	1	74.00	–	–	–	.01	–	–	.40	–	–	–	.01	–	–	–	–	–	–	–	–	–	1.43
Soap-grease refuse,	2	29.25	51.39	4.20	2.21	3.21	–	–	–	15.37	11.04	13.21	–	–	–	–	–	–	–	–	–	–	1.29
Soup from horse rendering,	1	92.14	–	–	–	1.12	–	–	–	–	–	.14	–	–	–	–	–	–	–	–	–	–	–
* Spent brewers' grain,	1	73.10	–	–	–	1.23	–	–	.07	–	–	.33	–	–	–	–	–	–	–	–	–	–	–
* Spent bone-black,	1	1.16	–	–	–	–	–	–	–	–	–	31.02	–	1.96	29.06	–	–	–	–	–	–	–	–
* Sugar-beet refuse,	1	7.70	–	–	–	6.39	–	–	9.72	–	–	–[1]	–	–	–	7.00	–[1]	–	–	2.82	–[1]	1.87	–
Sumac waste,	1	63.06	6.80	–	–	1.19	–	–	3.25	–	–	–	–	–	–	–	1.14	3.25	–	–	–	–	2.25
Starch waste from rubber factory,	1	10.01	.23	–	–	.02	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
* Sludge from sewage beds,	1	36.95	30.97	–	–	1.07	–	–	.20	–	–	.28	–	–	–	–	4.34	–	2.62	–	–	–	37.80
* Sludge from sewage-precipitating tanks,	4	37.74	–	1.31	.46	.91	.66	.07	.25	.86	.39	.61	–	–	–	–	3.10	2.19	8.55	.41	4.86	–	28.70
* Sewage,	4	54.11	72.89	1.04	.30	.55	.44	.09	.27	.42	.40	.63	–	–	–	–	–	2.79	–	–	–	.03	35.87

Salt mud,	2	53.37	41.19	.40	.39	.40	.33	.32	.33	–	–	–	–	–	–	.94	.91	.37	4.13	–	–	–	34.88
* Soot,	2	8.60	–	–	–	.77	1.57	.17	.87	.72	.23	.47	–	–	–	–	2.92	1.19	6.38	–	–	–	71.07
* Tankage,	76	8.02	–	11.27	4.11	5.88	–	–	–	21.62	.76	14.00	–	6.37	7.50	–	–	–	–	–	–	–	–
* Tobacco dust,	5	5.04	58.68	2.25	1.54	1.80	6.81	1.53	2.93	1.28	.36	.61	–	–	–	–	3.09	–	–	–	–	–	31.18
Tobacco leaves,	1	13.05	21.01	–	–	2.75	–	–	7.24	–	–	.43	–	–	–	–	4.17	2.17	.32	–	–	–	4.17
* Tobacco stems,	2	10.15	23.76	2.20	1.99	2.09	8.68	5.72	7.20	1.02	.32	.67	–	–	–	–	5.46	–	–	–	–	–	2.70
* Tobacco stalks exposed to the action of weather.	2	7.62	–	1.40	1.18	1.29	4.01	.52	2.26	.92	.38	.65	–	–	–	–	–	–	–	–	–	–	1.86
* Teopik fibre,	1	56.54	–	–	–	.53	–	–	1.26	–	–	.55	–	–	–	–	5.15	–	–	–	–	–	.75
Turf,	2	19.29	6.36	1.97	1.91	1.94	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
* Undried tankage,	1	29.00	–	–	–	1.06	–	–	–	–	–	3.51	–	2.94	.51	–	–	–	–	–	–	–	–
* Vegetable mould,	1	26.07	–	–	–	.62	–	–	.66	–	–	.45	–	–	–	–	–	–	–	–	–	–	–
* Wool dustings,	1	14.10	16.04	–	–	3.65	–	–	.29	–	–	.32	–	–	–	–	1.02	–	–	–	–	–	9.25
* Wool waste,	13	10.71	30.12	8.30	.39	3.05	5.92	.29	1.68	1.02	.05	.56	–	–	–	–	2.39	–	–	–	–	–	31.58
Wool washings, water,	1	–	–	–	–	–	–	–	3.92	–	–	–	–	–	–	.49	.28	–	–	–	–	–	–
* Wool waste and sheep manure,	1	7.13	–	–	–	2.63	–	–	2.20	–	–	.64	–	–	–	–	–	–	–	–	–	–	–
Wool washings, acid,	1	–	–	–	–	–	–	–	4.20	–	–	–	–	–	–	.40	.61	.20	–	–	–	–	–
Wool washings, alkaline,	1	92.03	3.28	–	–	.09	–	–	1.09	–	–	–	–	–	–	.92	.04	–	–	–	–	–	.22
Whale meat, raw,	1	44.50	1.04	–	–	4.86	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Waste from lactate factory,	1	34.11	–	–	–	.68	–	–	–	–	–	.67	–	–	–	–	22.59	–	–	–	–	–	6.92
* Whalebone scrapings,	1	6.90	–	–	–	13.01	–	–	–	–	–	.26	–	–	–	–	–	–	–	–	–	–	–
* Water abstract of dry forest leaves,	1	99.46	.16	–	–	.004	–	–	.03	–	–	.022	–	–	–	–	.025	–	–	–	–	–	–

[1] None.

4. *Guanos, Phosphates, etc.*

Fertilizer Materials.	Analyses.	Moisture.	Ash.	Nitrogen. Maximum.	Nitrogen. Minimum.	Nitrogen. Average.	Potash. Maximum.	Potash. Minimum.	Potash. Average.	Total Phosphoric Acid. Maximum.	Total Phosphoric Acid. Minimum.	Total Phosphoric Acid. Average.	Soluble Phosphoric Acid.	Reverted Phosphoric Acid.	Insoluble Phosphoric Acid.	Sodium Oxide.	Calcium Oxide (Lime).	Magnesium Oxide.	Ferric and Aluminic Oxides.	Sulphuric Acid.	Carbonic Acid.	Chlorine.	Insoluble Matter.
* Acid phosphate,	44	10.61	–	–	–	–	–	–	–	19.16	11.60	15.75	9.53	3.87	2.35	–	–	–	–	–	–	–	–
* Apatite,	2	.07	–	–	–	–	–	–	–	37.74	32.62	35.18	–	2.09	33.09	–	–	–	–	–	–	–	–
* Belgian phosphate,	1	.21	–	–	–	–	–	–	–	–	–	9.54	–	–	–	–	41.27	–	–	–	–	–	–
* Bone ash,	1	.34	–	–	–	–	–	–	–	–	–	39.14	–	–	–	–	–	–	–	–	–	–	–
Bone-black,	5	4.60	–	–	–	–	–	–	–	30.54	16.56	28.28	–	–	–	–	–	–	–	–	–	–	3.64
Brockville phosphate,	1	2.50	–	–	–	–	–	–	–	–	–	35.21	–	–	–	–	–	–	–	–	–	–	6 46
Bat guano from Texas,	9	40.09	18.24	10.51	2.58	6.47	–	–	1.31	6.53	1.00	3.76	–	–	–	–	–	–	–	–	–	–	2.00
Bat guano from Florida,	2	15.66	–	–	–	9.74	–	–	1.77	3.44	3.26	3.35	–	–	–	–	–	–	–	–	–	–	19.33
* Bat guano from Havana, Cuba,	2	5.83	–	6.96	1.70	4.33	1.20	.53	.86	14.00	5.04	9.52	–	–	–	6.17	11.04	–	5.76	–	–	–	9.47
Cuban guano,	5	24.27	–	2.74	.63	1.67	–	–	–	16.16	11.54	13.35	–	–	–	–	–	–	–	–	–	–	3.17
Caribbean guano (orchilla),	12	7.31	–	–	–	–	–	–	–	35.43	18.11	26.77	–	–	–	–	30.95	3.29	–	2.68	–	–	1.27
* Dissolved bone-black,	38	11.60	–	–	–	–	–	–	–	20.93	15.60	17.56	12.98	3.40	1.18	–	–	–	–	–	–	–	–
* Double superphosphate,	2	6.27	–	–	–	–	–	–	–	50.14	45.42	47.78	18.36	20.97	8.45	–	–	–	–	–	–	–	–
* Dissolved bone meal,	9	6.47	–	4.64	1.66	2.14	–	–	–	22.26	14.58	16.42	3.95	8.45	4.02	–	–	–	–	–	–	–	–
* Damaraland guano,	1	17.70	–	–	–	5.79	–	–	3.53	–	–	14.78	4.90	5.79	4.09	7.03	14.21	2.05	–	5.94	–	5.77	9.26
* Florida rock phosphate,	2	.53	–	–	–	–	–	–	–	40.34	33.10	36.72	–	.10	36.62	–	–	–	–	–	–	–	–
* Florida soft phosphate,	1	4.46	–	–	–	–	–	–	–	–	–	26.48	–	.38	26.10	–	–	–	–	–	–	–	–
* Mona Island guano,	1	13.32	–	–	–	.76	–	–	–	–	–	21.88	–	7.55	14.33	–	37.49	–	–	–	–	–	2.45

* Novassa phosphate,	1	5.77	-	-	-	-	-	-	-	-	-	24.56	-	1.66	22.90	-	-	-	-	-	-	-	-
Odorless phosphate,	6	2.99	-	-	-	-	.52	.04	.38	21.74	18.40	19.54	-	.52	19.82	-	51.42	-	-	-	2.51	-	9.14
* Phosphatic slag,	9	.57	-	-	-	-	-	-	-	21.78	14.71	17.73	-	5.27	12.46	-	39.60	-	-	-	-	-	-
* Peruvian guano,	30	13.58	37.61	13.50	4.44	6.36	4.08	1.14	2.62	20.60	5.96	14.85	3.72	5.49	5.64	-	12.85	-	-	-	-	-	6.60
Rat guano from Florida,	1	10.32	-	-	-	3.32	-	-	6.85	-	-	2.30	-	-	-	-	-	-	-	-	-	-	1.15
* South Carolina rock phosphate,	5	.80	-	-	-	-	-	-	-	31.87	25.58	28.06	-	3.40	24.60	-	-	-	-	-	-	-	-
South Carolina floats,	1	.83	-	-	-	-	-	-	-	-	-	23.39	-	2.33	21.06	-	-	-	-	-	-	-	20.16
South American bone ash,	1	7.00	-	-	-	-	-	-	-	-	-	35.89	-	-	-	-	44.89	-	-	-	-	-	4.50
* Tennessee phosphate,	1	.37	-	-	-	-	-	-	.44	-	-	33.00	-	-	-	-	-	-	-	-	-	-	-
Upton phosphate,	1	9.07	-	-	-	-	-	-	-	-	-	40.15	-	37.84	2.31	-	-	-	-	-	-	-	-

5. Animal Excrement, etc.

* Barnyard manure,	38	73.38	8.29	.60	.18	.42	.32	.25	.53	.59	.10	.31	-	-	-	-	-	-	-	-	-	-	5.57
* Compost,	1	1.70	-	-	-	.79			.97	-	-	.56	-								-	-	-
Drainage from manure heap,	1	93.20	3.66	-	-	.98	-		.88			.24	-	-							-	-	-
Goose manure,	1	48.92	-	-	-	.21			.81			.95			-	-	-						-
* Guinea-pig manure,	1	8.35	-	-	-	1.74	-	-	1.66	-		.55	-				.39					-	3.78
* Hen manure,	4	43.21	-	1.83	.42	.87	2.96	.43	1.11	3.93	.63	1.62	-				1.19	.89		1.24			23.09
Hen-house refuse,	2	7.37				.71			1.03	-	-	1.02		-									71.07
Horse manure,	1	11.24			-	.74	-		2.82			1.46	-										12.60
* Liquid manure,	1	96.56				.56		-	.02			.01											
Poudrette, dry,	1	5.25	35.45			3.58		-	.49			5.74											1.65
* Sheep manure,	10	8.33	17.60	2.97	.85	2.19	3.42	.68	2.13	2.24	.22	1.46					3.59						28.49

6. Average Per Cents. of Different Ingredients found in the Preceding Compilation of Analyses, calculated to Pounds per Ton of 2,000 Pounds.

Fertilizer Materials.	Moisture.	Ash.	Nitrogen.	Potash.	Total Phosphoric Acid.	Sodium Oxide.	Calcium Oxide (Lime).	Magnesium Oxide.	Ferric and Aluminic Oxides.	Sulphuric Acid.	Carbonic Acid.	Chlorine.	Insoluble Matter.
1. Chemicals, Refuse Salts, etc.													
*Carbonate of potash, high grade,	67.6	-	-	1,218.4	-	-	-	-	-	-	-	-	-
*Carbonate of potash,	364.4	-	-	384.8	-	-	-	390.4	-	-	-	-	7.8
Carnalite,	-	-	-	274	-	153	-	264	-	11	-	831	-
*Kainit,	63.6	-	-	249.4	-	379.4	47.4	127.4	-	405	-	412.8	42.6
Krugite,	96	-	-	168	-	105	249	176	-	639	-	133	299
*Muriate of potash,	31.2	-	-	997.8	-	133.8	-	11	-	-	-	976	14
*Nitrate of potash,	19.6	-	266	891.4	-	-	-	-	-	-	-	-	-
*Nitrate of soda,	30.4	-	309.4	-	-	710	-	-	-	-	-	10	10
*Nitre lime,	18.4	-	168.4	-	-	-	586	-	-	-	-	-	45.6
Nitre salt cake,	121	-	46	17	-	591	-	-	-	955	-	-	78
Phosphate of potash,	75	-	-	651	750	-	-	-	-	269	-	-	18
Phosphate of ammonia,	121	-	207	-	877	-	-	-	-	249	-	-	16
*Potash refuse from manufacture of cyanide of potash,	785	-	19	147	-	-	-	-	-	-	-	-	-
*Sulfate of ammonia,	19.8	-	414.8	-	-	-	-	-	-	1,200	-	-	-

*Sulfate of potash,	16.4	-	-	985	-	89.2	-	30	-	914.4	-	-	.15
*Sulfate of potash-magnesium,	76.6	-	-	506.8	-	125	51.4	277.2	-	894.4	-	39	45.2
*Silicate of potash,	157.2	-	-	411.8	-	-	-	-	-	-	-	-	-
*Sulfate of magnesia,	475	-	-	-	-	-	56	348	-	722	-	-	115
*Sulfate of soda,	28	-	-	-	-	-	-	-	-	1,189	-	-	-
Saltpetre waste,	51	-	44	273	-	741	15	4	-	37	-	925	-
*Vegetable potash,	72.6	-	-	519	51	-	413	-	-	-	-	-	194
2. *Ashes, Marls, Lime Compounds, etc.*													
Acetylene gas-tank refuse,	84	-	-	-	-	-	1,183	-	-	-	-	-	-
Ashes of spent tan bark,	97	-	-	36	27	-	622	68	36	-	-	-	504
Ashes from cremation of swill,	97	-	-	79	283	-	672	37	93	-	-	-	431
Ashes from blue works,	243	1,276	-	180	-	-	-	-	-	-	-	-	246
*Ashes from cremation of garbage,	60	-	-	103	175	313	404	23	184	91	217	95	568
*Ashes from hay and straw,	8	-	-	31	20	-	104	-	-	-	-	-	1,327
*Ashes from jute waste,	4	-	-	10	11	77	121	8	152	-	-	11	1,620
*Ashes from peach-tree trimmings,	11	-	-	98	49	151	375	-	210	44	-	-	271
*Ashes from soft coal and sawdust,	67.2	-	-	14.6	14.8	-	56	-	-	-	-	-	1,390.6
Ammoniated marl,	66	-	32	-	208	-	-	-	-	-	-	-	-
*Bleachery refuse,	84	-	-	16	-	234	716	-	-	-	-	-	462
Bituminous coal ashes,	73	-	-	8	9	-	38	-	-	-	-	-	1,483
*Brick-yard ashes,	11.6	-	-	69	29.4	-	486.6	-	-	-	-	-	952.6
*Coal and wood ashes,	26.4	-	-	8.80	23	-	47.8	-	-	-	-	-	1,618.8

6. *Average Per Cents. of Different Ingredients found in the Preceding Compilation of Analyses, calculated to Pounds per Ton of 2,000 Pounds* — Continued.

Fertilizer Materials.	Moisture.	Ash.	Nitrogen.	Potash.	Total Phosphoric Acid.	Sodium Oxide.	Calcium Oxide (Lime).	Magnesium Oxide.	Ferric and Aluminic Oxides.	Sulphuric Acid.	Carbonic Acid.	Chlorine.	Insoluble Matter.
2. *Ashes, Marls, Lime Compounds, etc.* — Con.													
* Cotton-seed hull ashes,	146.2	-	-	450.6	169.8	-	160.6	252.8	-	-	-	-	342.4
* Corn-cob ashes,	109.4	-	23.6	494.6	94.4	-	140	-	25.6	-	-	-	762.4
* Carbonate of lime,	9	-	-	-	-	-	1,046.2	-	-	-	-	-	-
Gypse,	33	-	-	-	-	-	1,017	-	-	-	-	-	57
Gas-house lime,	223.2	-	-	-	-	-	963.8	166	-	393.2	-	-	179.8
Green sand marl (Virginia),	25	-	-	23	187	-	516	-	103	-	-	-	826
* Hemp ashes,	-1	-	-	49.6	34.8	-	1,209.4	-	-	-	-	-	63.8
Hard-pine wood ashes,	15	-	-	203	45	-	499	-	-	-	-	-	598
* Lime refuse from soda factory,	481	-	-	-	-	-	297	-	27	463	-	-	33
Lime waste from sugar factory,	726	-	-	4	45	-	550	-	-	-	-	-	6
Lime,	-	-	-	-	-	-	1,873	-	-	-	-	-	27
* Lime-kiln ashes,	227	-	-	40.8	15.6	-	829.8	26	-	-	-	-	135.6
* Leather-scrap ashes,	118.8	-	3	44.6	57.8	-	156	-	-	-	-	-	921.6
Logwood ashes,	30	-	-	2	46	-	78	-	-	-	-	-	194

Mill ashes,	11	-	-	32	9	-	699	27	-	-	-	-	727
Magnolia ashes (Florida),	32	-	-	51	9	-	-	-	-	-	-	-	122
Massachusetts marls,	274	-	-	5	21	-	810	13	14	-	571	-	69
* Marl,	310.8	-	.02	5.80	.40	-	-[2]	-	-	-	-	-	-
Marl (North Carolina),	14	-	-	1	11	-	439	12	-	-	-	-	1,004
* Nova Scotia plaster (gypsum),	129	-	-	-	-	-	675	15	-	897	-	-	116
Olive earth (Virginia),	39	-	-	5	275	-	383	-	120	-	-	-	1,011
Onondaga plaster (New York gypsum),	265	-	-	-	-	-	600	93	-	650	164	-	197
* Oyster-shell lime,	-[1]	-	-	-	7.60	-	1,110.8	-	-	-	189	-	176.4
* Picker-waste ashes,	6	-	-	131	24	-	-	-	-	-	-	-	1,269
* Patent-process lime,	-[1]	-	-	-	-	-	1,157.4	-	-	-	-	-	180.6
Peat ashes,	93	-	-	9	2	-	46	33	123	-	-	-	903
* Prepared lime,	-[1]	-	-	-	-	79.8	1,389.6	10	31	-	-	-	-
* Pine-wood ashes,	55.2	-	-	87.4	61.4	-	472.2	-	-	-	-	-	749.2
* Peat,	906	409.4	18.4	.8	1.6	-	17.6	-	-	-	-	-	324.6
* Plastering,	144	-	-	-	4.40	-	2.30	-	-	-	-	-	13.30
* Pulp ashes,	-[1]	-	-	9.2	2.4	-	1,354.4	-	-	-	-	-	140
Railroad-tie ashes,	94	-	-	18	11	-	50	-	-	-	-	-	1,604
* Refuse ashes from sawdust,	278.4	-	-	71.6	154.4	-	695.2	-	-	-	-	-	505.1
Sea-weed ashes,	29	-	-	18	6	175	121	87	-	60	-	132	1,273
* Tan-bark ashes,	30	-	-	10.4	15.4	-	485.8	-	-	-	-	-	270.8

[1] None. [2] Trace.

6. Average Per Cents. of Different Ingredients found in the Preceding Compilation of Analyses, calculated to Pounds per Ton of 2,000 Pounds — Continued.

Fertilizer Materials.	Moisture.	Ash.	Nitrogen.	Potash.	Total Phosphoric Acid.	Sodium Oxide.	Calcium Oxide (Lime).	Magnesium Oxide.	Ferric and Aluminic Oxides.	Sulphuric Acid.	Carbonic Acid.	Chlorine.	Insoluble Matter.
2. *Ashes, Marls, Lime Compounds, etc.* — Con.													
Virginia marls,	320	–	–	10	2	–	145	4	–	13	145	–	1,285
* Waste lime,	16	–	–	–	–	–	1,482	–	–	–	–	–	8
* Waste lime from tannery,	17.6	–	13.13	–	–	–	1,083.6	–	–	–	–	–	76.6
* Walnut-wood ashes,	75.8	–	–	101.2	41.4	–	814.6	–	–	–	–	–	45.8
* Wood ashes,	241.6	–	–	184	28.4	–	659.6	66.2	148.6	–	–	–	330.2
* Wool-waste ashes,	168	–	–	544.8	5.2	–	57.6	–	–	–	–	–	556.4
* Wood charcoal,	73	–	–	8	3.2	–	–	–	–	–	–	–	31.6
3. *Refuse Substances.*													
Ammoniate,	118	–	227	–	69	–	–	–	–	–	–	–	28
* Blood and bone,	119	–	125	–	243	–	–	–	–	–	–	–	–
Bone soup,	1,658	141	23	–	25	–	–	–	–	–	–	–	–
* Bone from fish,	176	–	96	–	471	–	–	–	–	–	–	–	–
* Broom-corn seed,	148	–	30	10	11	–	–	–	–	–	–	–	–
* Bone dust,	101	–	61.2	–	356	–	–	–	–	–	–	–	–

* Banana skins,	280	–	5	109	36	–	–	–	–	–	–	–	–
Blue-green algæ (*Lyngbia majuscula*),	325	–	85	16	4	71	41	24	–	–	–	–	111
* Burned bone,	41.2	–	–	–	746.6	–	1,042.4	–	–	–	–	–	19.2
* Cassava waste,	180.6	–	6.60	5.60	1.20	–	12.20	–	–	–	–	–	–
* Coral formation,	785.2	–	5.6	2.8	4.2	–	462.8	27.8	–	–	–	–	339.6
* Cocoanut-fibre pith,	124	75.60	6.80	16.80	.06	–	11.4	–	–	–	–	–	20.2
* Cotton compost,	850.2	–	18.6	11.2	7.8	–	–	–	–	–	–	–	–
* Cotton-seed dust,	87.6	–	24.4	29.6	10.8	–	29.6	–	–	–	–	–	–
* Cotton-seed droppings,	81.6	–	19.2	37	4	–	13.2	–	–	–	–	–	–
* Cocoa shells,	77.6	–	46.6	49.6	7.2	–	15.2	–	–	–	–	–	–
* Cotton waste, dry,	129	271.4	20.6	–	6.4	–	34.6	–	–	–	–	–	292.2
* Concentrated wool washings,	823	–	22	203	2	–	–	–	–	–	–	–	–
* Condensed bone steam,	1,635	–	39	–	1	–	–	–	–	–	–	–	–
* Castor-bean pomace,	157.2	114	103.6	21	42.4	–	17.1	6.8	–	–	–	–	35
* Cotton-seed meal,	137	–	134.8	32.8	51.2	–	–	–	–	–	–	–	5.6
* Cork dust,	15	–	12	7	2	–	15	2	–	–	–	–	5
* Cotton waste, wet,	480.4	688.4	24.2	12.8	13	–	54.6	–	–	–	–	–	763.2
Cotton dust,	654	1,019	16	9	6	–	–	–	–	–	–	–	844
Dried soup from meat and bone,	296	168	199		11	–	–	–	–	–	–	–	13
Dried soup from rendering cattle feet,	216	150	289	–	9	–	–	–	–	–	–	–	5
* Dried blood,	209	–	203.2	–	50	–	–	–	–	–	–	–	–
* Dry ground fish,	177.4	–	167.2	–	177.4	–	–	–	–	–	–	–	–

6. Average Per Cents. of Different Ingredients found in the Preceding Compilation of Analyses, calculated to Pounds per Ton of 2,000 Pounds — Continued.

Fertilizer Materials.	Moisture.	Ash.	Nitrogen.	Potash.	Total Phosphoric Acid.	Sodium Oxide.	Calcium Oxide (Lime).	Magnesium Oxide.	Ferric and Aluminic Oxides.	Sulphuric Acid.	Carbonic Acid.	Chlorine.	Insoluble Matter.
3. *Refuse Substances* — Con.													
* Damaged grain,	843	–	29	6	11	–	–	–	–	–	–	–	–
* Deposit from Charles River,	429	–	19	12	15	–	36	–	–	–	–	–	885
* Dredgings from Cape Cod,	380	–	20	3	1	–	–	–	41	–	–	11	–
* Deposit from pond,	80	–	8	5	6	–	12	–	–	–	–	–	–
Eel grass,	708	312	17	18	6	33	43	2	–	–	–	–	21
Felt refuse,	585	671	105	–	–	–	–	–	–	–	–	–	–
* Fleshings,	139	863	151	–	6	–	–	–	–	–	–	–	–
* Fresh-cut bone,	500	–	60	–	337	–	–	–	–	–	–	–	–
* Factory waste,	262.2	644	31	71.4	12	–	260.4	–	–	134.6	–	–	122.8
* Fibre waste,	1,230.6	–	4.4	9.8	2	–	7.2	–	–	–	–	–	11.6
Fish with 20 to 40 per cent. water,	604	412	119	–	142	–	–	–	–	–	–	–	34
Fish with more than 40 per cent. water,	909	310	99	–	112	–	–	–	–	–	–	–	27
Fresh-water mud,	807	–	27	4	5	–	25	6	36	–	–	–	365
* Garbage tankage,	42.4	–	119	–	121.2	–	–	–	–	–	–	–	–

* Ground bone, damaged by salt water,	656.2	-	35.6	-	344.2	-	-	-	-	-	-	-	-
* Ground tobacco stems,	177	404	40	123	12	-	135	-	-	-	-	-	26
* Ground bones,	120.6	1,282.8	61.2	-	486.8	-	-	-	-	-	-	-	21.6
Glucose refuse,	162	-	52	3	6	-	4	4	-	-	-	-	1
German peat moss,	190	22.8	14.4	1.2	1	-	4.2	-	-	-	-	-	7.2
Horn shavings,	97	-	306	-	8	-	-	-	-	-	-	-	-
* Horn dust,	172.6	-	292	-	.8	-	-	-	-	-	-	-	-
* Hoof meal,	82	-	304	-	15	-	-	-	-	-	-	-	-
Horn and hoof waste,	203	153	265	-	37	-	-	-	-	-	-	-	5
* Hair waste,	130	455	184	3	10	82	-	-	-	-	-	-	-
* Hop refuse,	1,691	34	12	1	2	-	-	-	-	-	-	-	17
Ivory dust,	230	1,053	133	-	491	-	-	-	-	-	-	-	-
* Jadoo fibre,	201	232	17.4	8.6	15	-	70	-	-	-	-	-	81
Jute waste,	262	-	30	2	14	-	-	-	-	-	-	-	-
* Kiln dust from brewery,	194	-	86	43	19	-	16	-	-	-	-	-	142
* Linseed meal,	173	-	115.6	30.4	29.4	-	-	-	-	-	-	-	11.6
Lobster shells,	145	-	90	-	70	-	415	26	-	-	-	-	5
* Meat meal,	64	171	185	-	62	-	-	-	-	-	-	-	-
Meat mass,	242	272	209	-	41	-	-	-	-	-	-	-	42
Meat scrap,	496	-	127	-	116	-	-	-	-	-	-	-	-
Morocco factory waste,	454	-	23	7	54	-	392	-	-	25	-	-	183
* Meat and bone,	172.8	-	105.8	-	336.2	-	-	-	-	-	-	-	-

6. *Average Per Cents. of Different Ingredients found in the Preceding Compilation of Analyses, calculated to Pounds per Ton of 2,000 Pounds* — Continued.

FERTILIZER MATERIALS.	Moisture.	Ash.	Nitrogen.	Potash.	Total Phosphoric Acid.	Sodium Oxide.	Calcium Oxide (Lime).	Magnesium Oxide.	Ferric and Aluminic Oxides.	Sulphuric Acid.	Carbonic Acid.	Chlorine.	Insoluble Matter.
3. *Refuse Substances* — Con.													
* Mill waste,	90	-	26.8	11.6	21.4	-	-	-	-	-	-	-	-
Mill sweepings,	190	-	75	13	24	-	-	-	-	-	-	-	100
* Milk cassein,	143	-	146	15.2	161.2	-	235.6	-	28	-	-	-	2
Madder,	239	-	18	48	7	-	79	10	-	-	-	-	93
Mussel mud, wet,	1,200	546	4	123	2	14	19	3	70	-	-	-	-
Mussel mud, dry,	45	1,440	14	-	7	-	468	-	165	-	-	-	752
* Muck and peat, wet.	1,351 6	199.4	9.2	1	1.2	-	7.40	-	-	-	-	-	134.6
* Muck and peat, dry,	133	1,391	17	-	6	-	15	-	-	-	-	-	-
* Mud,	840.4	895.2	7	3	4	-	1.8	-	-	-	-	-	-
Oleomargarine refuse,	171	288	242	-	18	-	-	-	-	-	-	-	19
* Paper-mill dustings,	133.6	468.2	7	12	2.6	-	6	-	-	88	-	-	284.6
* Product from garbage plant,	83	51	-	10	138	-	-	-	-	-	-	-	330
Pine barren grass,	170	48	3	1	4	-	-	-	-	-	-	-	33
Pine needles,	190	68	9	1	2	-	-	-	-	-	-	-	24

Raw wool,	139	151	258	-	-	-	-	-	-	-	-	-	73
*Rawhide dust,	290	-	278.2	-	21.2	-	-	-	-	-	-	-	-
Rotten brewers' grain,	1,575	-	14	1	9	-	5	3	-	-	-	-	12
Refuse from calico works,	81	-	86	-	239	-	-	-	-	-	-	-	-
*Refuse from glucose factory,	3	-	-	-	855	-	776	-	58	60	-	-	-
*Refuse from glass factory,	330	-	-	390	-	122	-	-	-	-	-	-	-
Rockweed, green,	1,370	474	12	-	-	-	-	-	-	-	-	-	-
Rockweed, dry,	274.6	715	25.2	64.4	28.8	119.4	97.6	19.2	24.4	-	-	3.2	-
Residue from water filter,	1,884	-	2	-	1	-	-	-	-	-	-	-	-
*Silt deposit,	143	-	22.8	7.8	5	-	14	-	-	-	-	-	-
Sponge refuse,	145	-	49	-	64	-	79	25	-	-	-	-	781
*Sizing paste,	1,245.6	-	32.6	3.6	-	-	-	-	-	-	-	-	-
*Sizing waste,	1,480	-	.2	8	.2	-	-	-	-	-	-	-	29
*Sludge from sewage beds,	739	619.4	21.4	4	5.6	-	86.8	-	52.4	-	-	-	75.6
Soap-grease refuse,	585	1,028	22	-	3	-	-	-	-	-	-	-	26
Soup from horse rendering,	1,462	-	24.6	1.4	6.6	-	-	-	-	-	-	-	-
*Spent brewers' grain,	1,842.8	-	22.4	2.8	-	-	-	-	-	-	-	-	-
*Spent bone-black,	23	-	-	-	620	-	-	-	-	-	-	-	-
*Sugar-beet refuse,	154	-	127.8	194.4	-[1]	140	-[1]	-	-	56.4	-[1]	37.4	-
Sumac waste,	1,261	136	24	65	-	-	23	65	-	-	-	-	45
Starch waste from rubber factory,	200	5	.4	-	-	-	-	-	-	-	-	-	-

[1] None.

6. Average Per Cents. of Different Ingredients found in the Preceding Compilation of Analyses, calculated to Pounds per Ton of 2,000 Pounds — Continued.

Fertilizer Materials.	Moisture.	Ash.	Nitrogen.	Potash.	Total Phosphoric Acid.	Sodium Oxide.	Calcium Oxide (Lime).	Magnesium Oxide.	Ferric and Aluminic Oxides.	Sulphuric Acid.	Carbonic Acid.	Chlorine.	Insoluble Matter.
3. Refuse Substances — Con.													
* Sludge from sewage-precipitating tanks,	755	-	18	5	12	-	62	44	171	8	97	-	574
* Sewage,	1,082.2	1,452.8	11	5.4	12.6	-	-	-	55.8	-	-	6.6	617.4
Salt mud,	1,067	824	8	7	-	19	18	7	83	-	-	-	698
* Salt marsh mud,	1,201	646.4	4.8	2.8	1.6	-	2.2	-	-	-	-	41.2	757.6
* Soot,	172	-	15	17	9	-	58	24	128	-	-	-	1,421
* Tankage,	160.4	-	117.6	-	28.0	-	-	-	-	-	-	-	-
* Tobacco dust,	100.8	1,173.6	36	58.6	12.2	-	61.8	-	-	-	-	-	623.6
* Tobacco stems,	203	475.2	41.8	144	13.4	-	109.2	-	-	-	-	-	54
Tobacco leaves,	261	420	55	145	9	-	83	43	6	-	-	-	83
* Tobacco stalks exposed to the action of weather,	152.4	-	25.8	45.2	13	-	-	-	-	-	-	-	37.2
* Teopik fibre,	1,131	-	11	25	11	-	103	-	-	-	-	-	15
Turf,	386	127	39	-	-	-	-	-	-	-	-	-	-
* Undried tankage,	580	-	21	-	70	-	-	-	-	-	-	-	-
* Wool waste,	214.2	602.4	61	33.6	11.2	-	47.8	-	-	-	-	-	601.6

* Wool dustings,	282	320.8	73	5.8	6.4	-	20.4	-	-	-	-	-	185
Wool washings, water,	-	-	-	7.8	-	10	6	-	-	-	-	-	-
Wool washings, acid,	-	-	-	8.4	-	8	12	.4	-	-	-	-	-
Wool washings, alkaline,	1,841	66	2	22	-	18	1	-	-	-	-	-	4
Whale meat, raw,	890	21	9.7	-	-	-	-	-	-	-	-	-	-
* Wool waste and sheep manure,	142.6	-	52.6	44	12.8	-	-	-	-	-	-	-	-
Waste from lactate factory,	682	-	14	-	13	-	452	-	-	-	-	-	138
* Whalebone scrapings,	14	-	260	-	5	-	-	-	-	-	-	-	-
* Water abstract of dry forest leaves,	1,989	3	.08	.6	.44	-	.5	-	-	-	-	-	-
Vegetable mould,	521.4	-	12.4	13.2	9	-	-	-	-	-	-	-	-
4. Guanos, Phosphates, etc.													
* Acid phosphate,	212.2	-	-	-	315	-	-	-	-	-	-	-	-
* Apatite,	1	-	-	-	704	-	-	-	-	-	-	-	-
* Bone ash,	7	-	-	-	783	-	-	-	-	-	-	-	-
* Belgian phosphate,	4.2	-	-	-	190.8	-	825.4	-	-	-	-	-	-
Bone-black,	92	-	-	-	566	-	-	-	-	-	-	-	73
Brockville phosphate,	5.0	-	-	-	70.4	-	-	-	-	-	-	-	129
Bat guano from Texas,	80.2	365	129	26	75	-	-	-	-	-	-	-	40
Bat guano from Florida,	313	-	195	35	67	-	-	-	-	-	-	-	387
* Bat guano from Havana, Cuba,	116.6	-	86.6	17.2	90.4	123.4	220.8	-	115.2	-	-	-	189.4
Cuban guano,	485	-	33	-	267	-	-	-	-	-	-	-	63
Caribbean guano (orchilla),	146	-	-	-	535	-	799	66	-	54	-	-	25

6. *Average Per Cents. of Different Ingredients found in the Preceding Compilation of Analyses, calculated to Pounds per Ton of 2,000 Pounds* — Concluded.

Fertilizer Materials.	Moisture.	Ash.	Nitrogen.	Potash.	Total Phosphoric Acid.	Sodium Oxide.	Calcium Oxide (Lime).	Magnesium Oxide.	Ferric and Aluminic Oxides.	Sulphuric Acid.	Carbonic Acid.	Chlorine.	Insoluble Matter.
4. *Guanos, Phosphates, etc.* — Con.													
* Dissolved bone-black,	232	-	-	-	351.2	-	-	-	-	-	-	-	-
* Double superphosphate,	125	-	-	-	956	-	-	-	-	-	-	-	-
* Dissolved bone meal,	129.4	-	428	-	328.4	-	-	-	-	-	-	-	-
* Damaraland guano,	354	-	116	71	296	141	284	41	-	119	-	115	185
* Florida rock phosphate,	11	-	-	-	734	-	-	-	-	-	-	-	-
* Florida soft phosphate,	89	-	-	-	530	-	-	-	-	-	-	-	-
* Mona Island guano,	266	-	15	-	438	-	750	-	-	-	-	-	49
* Novassa phosphate,	115	-	-	-	491	-	-	-	-	-	-	-	-
Odorless phosphate,	60	-	-	8	391	-	1,028	-	-	-	50	-	183
* Phosphatic slag,	11.4	-	-	-	354.6	-	792	-	-	-	-	-	-
Peruvian guano,	271.6	752.2	127.2	52.4	247	-	257	-	-	-	-	-	132
Rat guano from Florida,	206	-	66	137	46	-	-	-	-	-	-	-	23
* South Carolina rock phosphate,	16	-	-	-	561.2	-	-	-	-	-	-	-	-
South Carolina floats,	17	-	-	-	468	-	-	-	-	-	-	-	403

South American bone ash,	14.0	-	-	-	718	-	898	-	-	-	-	-	90
*Tennessee phosphate,	7	-	-	9	660	-	-	-	-	-	-	-	-
Upton phosphate,	181	-	-	-	803	-	-	-	-	-	-	-	-
5. Animal Excrement, etc.													
*Barnyard manure,	1,466.6	165.8	8.4	10.6	6.2	-	-	-	-	-	-	-	111.4
*Compost,	34	-	15.8	19.4	11.2	-	-	-	-	-	-	-	-
Drainage from manure heap,	1,864	73	19.6	17.6	48	-	-	-	-	-	-	-	-
Goose manure,	978	-	4.2	16.2	19	-	-	-	-	-	-	-	-
*Hen manure,	864.2	-	17.4	22.2	32.4	-	238	17.8	-	24.8	-	-	461.8
Hen-house refuse,	147	-	14.2	20.6	20.4	-	-	-	-	-	-	-	1,421
Horse manure,	225	-	14.8	56.4	29.2	-	-	-	-	-	-	-	252
Guinea-pig manure,	167	-	34.8	33.2	11	-	7.8	-	-	-	-	-	75.6
*Liquid manure,	1,931.2	-	11.2	.4	.2	-	-	-	-	-	-	-	-
Poudrette, dry,	105	709	71.6	9.8	115	-	-	-	-	-	-	-	93
*Sheep manure,	166.6	352	43.8	42.6	29.2	-	67.2	-	-	-	-	-	569.8

Compilation of Analyses of Fruits, Garden Crops and Insecticides.

H. D. HASKINS.

1. Analyses of fruits.
2. Analyses of garden crops.
3. Relative proportions of phosphoric acid, potassium oxide and nitrogen in fruits and garden crops.
4. Analyses of insecticides.

The results of chemical analyses of twenty prominent garden crops (green) show the following average composition, expressed in parts per thousand: —

Nitrogen,	4.1
Potassium oxide,	3.9
Phosphoric acid,	1.9

A computation of the results of the above analyses of green garden vegetables shows the following relative proportion of the three essential ingredients of plant food: —

Nitrogen,	2.2
Potassium oxide,	2.0
Phosphoric acid,	1.0

The weight and particular stage of growth of the vegetables when harvested control, under otherwise corresponding conditions, the actual consumption of each of these articles of plant food. Our information regarding these points is still too fragmentary to enable a more detailed statement here beyond relative proportions. It must suffice for the present to call attention to the fact that a liberal manuring within reasonable limits pays, as a rule, better than a scanty one. (C. A. Goessmann.)

1. Analyses of Fruits.

Fertilizing Constituents of Fruits (Parts per Thousand).

	Moisture.	Nitrogen.	Ash.	Potassium Oxide.	Sodium Oxide.	Calcium Oxide.	Magnesium Oxide.	Phosphoric Acid.	Sulphuric Acid.	Chlorine.
Ericaceæ: —										
* Cranberries,	996	–	1.8	.9	.1	.3	.1	.3	–	–
* Cranberries,	894	.8	–	1.0	–	.2	.1	.3	–	–
Rosaceæ: —										
Apples,	831	.6	2.2	.8	.6	.1	.2	.3	.1	–
* Apples,	799	1.3	4.1	1.9	.3	.3	.3	.1	–	–
* Peaches,	884	–	3.4	2.5	–	.1	.2	.5	–	–
Pears,	831	.6	3.3	1.8	.3	.3	.2	.5	.2	–
Strawberries,	902	–	3.3	.7	.9	.5	–	.5	.1	.1
* Strawberries,	–	–	5.2	2.6	.2	.7	.4	1.0	–	–

Fertilizing Constituents of Fruits — Concluded.

	Moisture.	Nitrogen.	Ash.	Potassium Oxide.	Sodium Oxide.	Calcium Oxide.	Magnesium Oxide.	Phosphoric Acid.	Sulphuric Acid.	Chlorine.
Rosaceæ — *Con.*										
* Strawberry vines,	–	–	33.4	3.5	4.5	12.2	1.3	4.8	–	–
Cherries,	825	–	3.9	2.0	.1	.3	.2	.6	.2	.1
Plums,	838	–	2.9	1.7	–	.3	.2	.4	.1	–
Saxifragaceæ: —										
* Currants, white,	–	–	5.9	3.1	.2	1.0	.3	1.1	–	–
* Currants, red,	871	–	4.1	1.9	.2	.8	.3	.9	–	–
Gooseberries,	903	–	3.3	1.3	.3	.4	.2	.7	–	–
Viticeæ: —										
Grapes,	830	1.7	8.8	5.0	.1	1.0	.4	1.4	.5	.1
Grape seed,	110	19.0	22.7	6.9	.5	5.6	1.4	7.0	.8	.1

2. Analyses of Garden Crops.

Fertilizing Constituents of Garden Crops (Parts per Thousand).

	Moisture.	Nitrogen.	Ash.	Potassium Oxide.	Sodium Oxide.	Calcium Oxide.	Magnesium Oxide.	Phosphoric Acid.	Sulphuric Acid.	Chlorine.
Chenopodiaceæ: —										
Mangolds,	880	1.8	9.1	4.8	1.5	.3	.4	.8	.3	.9
* Mangolds,	873	1.9	12.2	3.8	1.3	.6	.4	.9	–	–
Mangold leaves,	905	3.0	14.6	4.5	2.8	1.6	1.4	1.0	.8	2.3
Sugar beets,	805	1.6	7.1	3.8	.6	.4	.6	.9	.3	.3
* Sugar beets,	869	2.2	10.4	4.8	.8	.6	.4	1.0	.1	–
Sugar beet tops,	840	2.0	9.6	2.8	2.3	.9	1.1	1.2	.2	.3
Sugar beet leaves,	897	3.0	15.3	4.0	2.0	3.1	1.7	.7	.8	1.3
Sugar beet seed,	146	–	45.3	11.1	4.2	10.2	7.3	7.5	2.0	1.9
* Red beets,	877	2.4	11.3	4.4	.9	.5	.3	.9	–	–

Fertilizing Constituents of Garden Crops — Continued.

	Moisture.	Nitrogen.	Ash.	Potassium Oxide.	Sodium Oxide.	Calcium Oxide.	Magnesium Oxide.	Phosphoric Acid.	Sulphuric Acid.	Chlorine.
Chenopodiaceæ — *Con.*										
Spinach,	903	2.4	16.0	2.7	5.7	1.9	1.0	1.6	1.1	1.0
* Spinach,	922	3.4	9.6	9.6	2.1	.6	.5	.5	–	–
Compositæ: —										
Lettuce, common,	940	–	8.1	3.7	.8	.5	.2	.7	.3	.4
Head lettuce,	943	2.2	10.3	3.9	.8	1.5	.6	1.0	.4	.8
* Head lettuce,	970	1.2	–	2.3	.2	.3	.1	.3	–	–
Roman lettuce,	925	2.0	9.8	2.5	3.5	1.2	.4	1.1	.4	.4
Artichoke,	811	–	10.1	2.4	.7	1.0	.4	3.9	.5	.2
* Artichoke, Jerusalem,	775	4.6	–	4.8	–	–	–	1.7	–	–

Convolvulaceæ: —										
Sweet potato,	758	2.4	7.4	3.7	.5	.7	.3	.8	.4	.9
Cruciferæ: —										
White turnips,	920	1.8	6.4	2.9	.6	.7	.2	.8	.7	.3
* White turnips,	895	1.8	10.1	3.9	.8	.9	.3	1.0	1.0	–
White turnip leaves,	898	3.0	11.9	2.8	1.1	3.9	.5	.9	1.1	1.2
* Ruta-bagas,	891	1.9	10.6	4.9	.7	.9	.3	1.2	–	–
Savoy cabbage,	871	5.3	14.0	3.9	1.4	3.0	.5	2.1	1.2	1.1
White cabbage,	900	3.0	9.6	4.3	.8	1.2	.4	1.1	1.3	.5
* White cabbage,	984	2.3	–	3.4	.3	.2	.1	.2	–	–
Cabbage leaves,	890	2.4	15.6	5.8	1.5	2.8	.6	1.4	2.4	1.3
Cauliflower,	904	4.0	8.0	3.6	.5	.5	.3	1.6	1.0	.3
Horse-radish,	767	4.3	19.7	7.7	.4	2.0	.4	2.0	4.9	.3
Radishes,	933	1.9	4.9	1.6	1.0	.7	.2	4.5	.3	.5
Kohlrabi,	850	4.8	12.3	4.3	.8	.4	.8	2.7	1.1	.6

Fertilizing Constituents of Garden Crops — Continued.

	Moisture.	Nitrogen.	Ash.	Potassium Oxide.	Sodium Oxide.	Calcium Oxide.	Magnesium Oxide.	Phosphoric Acid.	Sulphuric Acid.	Chlorine.
Cucurbitaceæ : —										
Cucumbers.	956	1.6	5.8	2.4	.6	.4	.2	1.2	.4	.4
Pumpkins,	900	1.1	4.4	.9	.9	.3	.2	.7	.3	.4
Gramineæ : —										
Corn, whole plant, green,	829	1.9	10.4	3.7	.5	1.4	1.1	1.0	.3	.5
* Corn, whole plant, green,	786	4.1	–	3.8	.5	1.5	.9	1.5	–	–
Corn, kernels,	144	16.0	12.4	3.7	.1	.3	1.9	5.7	.1	.2
* Corn, kernels,	100	18.2	–	4.0	.3	.3	2.1	7.0	–	–
* Corn, whole ears,	90	14.1	–	4.7	.6	.2	1.8	5.7	–	–
* Corn stover,	282	11.2	37.4	13.2	7.9	5.2	2.6	3.0	–	–

Leguminosæ: —										
Hay of peas cut green,	167	22.9	62.4	23.2	2.3	15.6	6.3	6.8	5.1	2.0
* Cow-pea (*Dolichos*), green,	788	2.9	–	3.1	.6	3.0	1.0	1.0	–	–
* Small pea (*Lathyrus Sylvestris*), dry,	90	38.5	–	25.7	4.7	17.9	5.0	9.0	–	–
Peas, seed,	143	35.8	23.4	10.1	.2	1.1	1.9	8.4	.8	.4
Pea straw,	160	10.4	43.1	9.9	1.8	15.9	3.5	3.5	2.7	2.3
Garden beans, seed,	150	39.0	27.4	12.1	.4	1.5	2.1	9.7	1.1	.3
Bean straw,	166	–	40.2	12.8	3.2	11.1	2.5	3.9	1.7	3.1
* Velvet beans, kernel,	111.6	31.1	–	13.2	–	–	–	7.7	–	–
* Velvet beans, with pod,	115.2	19.6	–	13.1	–	–	–	8.4	–	–
* Leaves and stems of velvet beans,	58.8	28.6	–	–	–	–	–	–	–	–
Liliaceæ: —										
* Asparagus,	942	3.3	–	3.29	–	–	–	1.08	–	–
Asparagus,	933	3.2	5.0	1.2	.9	.6	.2	.9	.3	.3

Fertilizing Constituents of Garden Crops — Concluded.

	Moisture.	Nitrogen.	Ash.	Potassium Oxide.	Sodium Oxide.	Calcium Oxide.	Magnesium Oxide.	Phosphoric Acid.	Sulphuric Acid.	Chlorine.
Liliaceæ — *Con.*										
Onions.	860	2.7	7.4	2.5	.2	1.6	.3	1.3	.4	.2
* Onions.	892	–	4.9	1.8	.1	.4	.2	.7	–	–
Solanaceæ : —										
Potatoes.	750	3.4	9.5	5.8	.3	.3	.5	1.6	.6	.3
* Potatoes.	798	2.1	9.9	2.9	.1	.1	.2	.7	–	–
Potato tops, nearly ripe.	770	4.9	19.7	4.3	.4	6.4	3.3	1.6	1.3	1.1
Potato tops, unripe.	825	6.3	16.5	4.4	.3	5.1	2.4	1.2	.8	.9
* Tomatoes.	940	1.7	–	3.6	–	.3	.2	.4	–	–
Tobacco leaves.	180	34.8	140.7	40.7	4.5	50.7	10.4	6.6	8.5	9.4

* Tobacco, whole leaf,	103.1	24.3	–	57.9	24.7	45.8	13.8	4.3	16.3	1.59
Tobacco stalks,	180	21.6	64.7	28.2	6.6	12.4	.5	9.2	2.2	2.4
* Tobacco stems,	106	22.9	140.7	64.6	3.4	38.9	12.3	6.0	–	–
Umbelliferæ: —										
Carrots,	850	2.2	8.2	3.0	1.7	.9	.4	1.1	.5	.4
* Carrots,	898	1.5	9.2	5.1	.6	.7	.2	.9	–	–
Carrot tops,	822	5.1	23.9	2.9	4.7	7.9	.8	1.0	1.8	2.4
Carrot tops, dry,	98	31.3	125.2	48.8	40.3	20.9	6.7	6.1	–	–
Parsnips,	793	5.4	10.0	.4	.2	1.1	.6	1.9	.5	.4
* Parsnips,	803	2.2	–	6.2	.1	.9	.5	1.9	–	–
Celery,	841	2.4	17.6	7.6	–	2.3	1.0	2.2	1.0	2.8

Many of the foregoing analyses were compiled from the tables of E. Wolff. Those marked with a star (*) are from analyses made at the Massachusetts State Agricultural Experiment Station, Amherst, Mass., and since 1895, at the chemical division of the Hatch Experiment Station of the Massachusetts Agricultural College.

3. Relative Proportions of Phosphoric Acid, Potassium Oxide and Nitrogen in Fruits and Garden Crops.

	Phosphoric Acid.	Potassium Oxide.	Nitrogen.
Fruits.			
Ericaceæ: —			
* Cranberries, ...	1	3.0	–
* Cranberries, ...	1	3.33	2.66
Rosaceæ: —			
Apples, ...	1	2.7	2.0
* Apples, ...	1	1.9	1.3
* Peaches, ...	1	1.3	–
Pears, ...	1	3.6	1.2
Strawberries, ...	1	1.4	–
* Strawberries, ...	1	2.6	–
* Strawberry vines, . . .	1	.7	–
Cherries, ...	1	3.3	–
Plums, ...	1	4.3	–
Saxifragaceæ: —			
* Currants, white, . . .	1	2.8	–
* Currants, red, . . .	1	2.1	–
Gooseberries, ...	1	1.9	–

3. Relative Proportions of Phosphoric Acid, etc., in Fruits and Garden Crops — *Continued.*

	Phosphoric Acid.	Potassium Oxide.	Nitrogen.
Viticeæ: —			
Grapes, ...	1	3.6	1.2
Grape seed, ...	1	1.0	2.7
Garden Crops.			
Chenopodiaceæ: —			
Mangolds, ...	1	6.0	2.3
* Mangolds, ...	1	4.2	2.1
Mangold leaves, . . .	1	4.5	3.0
Sugar beets, ...	1	4.2	1.8
* Sugar beets, ...	1	4.8	2.2
Sugar beet tops, . . .	1	2.3	1.7
Sugar beet leaves, . . .	1	5.7	4.3
Sugar beet seed, . . .	1	1.5	–
* Red beets, ...	1	4.1	3.3
Spinach, ...	1	1.7	3.1
* Spinach, ...	1	19.2	6.8
Compositæ: —			
Lettuce, common, ...	1	5.3	–
Head lettuce, ...	1	3.9	2.2
* Head lettuce, ...	1	7.7	4.0
Roman lettuce, ...	1	2.3	1.8
Artichoke, ...	1	.63	–
* Artichoke, Jerusalem, . .	1	2.8	2.7

3. Relative Proportions of Phosphoric Acid, etc., in Fruits and Garden Crops — *Continued.*

	Phosphoric Acid.	Potassium Oxide.	Nitrogen.
Convolvulaceæ: —			
Sweet potato,	1	4.6	3.0
Cruciferæ: —			
White turnips,	1	3.6	2.3
* White turnips,	1	3.9	1.8
White turnip leaves,	1	3.1	3.3
* Ruta-bagas,	1	4.1	1.6
Savoy cabbage,	1	1.9	2.5
White cabbage,	1	4.1	1.7
* White cabbage,	1	11.0	7.6
Cabbage leaves,	1	4.1	1.7
Cauliflower,	1	2.3	2.5
Horse-radish,	1	3.9	2.2
Radishes,	1	3.2	3.8
Kohlrabi,	1	1.6	1.8
Cucurbitaceæ: —			
Cucumbers,	1	2.0	1.3
Pumpkins,	1	.6	.7
Gramineæ: —			
Corn, whole plant, green,	1	3.7	1.9
* Corn, whole plant, green,	1	2.2	2.8
Corn, kernels,	1	.6	2.8
* Corn, kernels,	1	.6	2.6

3. Relative Proportions of Phosphoric Acid, etc., in Fruits and Garden Crops — *Continued.*

	Phosphoric Acid.	Potassium Oxide.	Nitrogen.
Gramineæ — *Con.*			
* Corn, whole ears, ...	1	.8	2.5
* Corn, stover, . . .	1	4.4	3.7
Leguminosæ: —			
Hay of peas, cut green, .	1	3.4	3.4
* Cow-pea (*Dolichos*), green, .	1	3.1	2.9
* Small pea (*Lathyrus sylvestris*), dry.	1	3.4	4.2
Peas, seed, ...	1	1.2	4.3
Pea straw, ...	1	2.8	4.0
Garden beans, seed, . .	1	1.2	4.0
Bean straw, ...	1	3.3	–
* Velvet beans, kernel, . .	1	1.7	4.0
* Velvet beans, with pod, .	1	1.56	2.3
* Leaves and stems of velvet beans.	–	–	–
Liliaceæ: —			
* Asparagus, ...	1	3.05	3.06
Asparagus, ...	1	1.3	3.6
Onions, ...	1	1.9	2.1
* Onions, ...	1	2.6	–
Solanaceæ: —			
Potatoes, ...	1	3.6	2.1
* Potatoes, ...	1	4.1	3.0
Potato tops, nearly ripe, .	1	2.7	3.1

3. Relative Proportions of Phosphoric Acid, etc., in Fruits and Garden Crops — *Concluded.*

	Phosphoric Acid.	Potassium Oxide.	Nitrogen.
Solanaceæ — *Con.*			
Potato tops, unripe,	1	3.7	5.3
* Tomatoes,	1	8.7	4.5
Tobacco leaves,	1	6.2	5.3
* Tobacco, whole leaf,	1	13.46	5.65
Tobacco stalks,	1	3.1	2.7
* Tobacco stems,	1	10.7	3.8
Umbelliferæ: —			
Carrots,	1	2.7	2.0
* Carrots,	1	5.7	1.7
Carrot tops,	1	2.9	5.1
Carrot tops, dry,	1	8.0	5.1
Parsnips,	1	3.8	2.8
* Parsnips,	1	3.3	1.2
Celery,	1	3.5	1.1

4. Analyses of Insecticides.

	Moisture.	Arsenious Oxide.	Copper Oxide.	Lead Oxide.	Zinc Oxide.	Barium Oxide.	Acetic Acid.	Nicotine.	Mercury.	Sulphur.	Sulphuric Acid.	Chlorine.	Calcium Oxide.	Potassium Oxide.	Ferric and Aluminic Oxides.	Insoluble Matter in Hydrochloric Acid.
Average of twenty analyses, Paris green,	.88	59.00	30.89	-	-	-	4.74	-	-	-	-	-	-	-	-	.20
Average of four analyses, "Lion brand, new-process Paris green."	4.64	54.91	7.93	-	-	-	-	-	-	-	6.65	-	15.76	.35	-	1.00
Average of fourteen analyses of Paris green collected in the general markets in 1900–01.	.81	57.73	29.45	-	-	-	-	-	-	-	-	-	-	-	-	-
Pink arsenoid (lead arsenite),	.35	40.16	-	53.83	-	-	-	-	-	-	-	-	-	-	-	-
Green arsenoid (copper arsenite),	1.44	50.77	31.90	-	-	-	-	-	-	-	-	-	-	-	-	-
White arsenoid (barium arsenite),	2.35	31.90	-	.96	-	48.31	-	-	-	-	-	3.19	-	-	-	-
Laurel green,	7.64	7.34	13.50	-	-	-	-	-	-	-	-	-	26.31	-	-	-
Bug death,	.03	-	-	1.58	78.86	-	-	-	-	-	-	-	-	-	3.80	-
Sulphatine,	1.40	-	2.61	-	-	-	-	-	-	48.28	4.73	-	18.60	-	-	1.63
Death to rose bugs,	2.95	-	1.05	-	-	-	-	-	-	34.53	4.35	-	17.76	-	-	.49
Professor De Graff's carpet bug destroyer,	95.81	-	-	-	-	-	-	-	.78	-	.48	.27	-	.26	.90	-
Oriental fertilizer and bug destroyer,	87.14	2.38	-	-	-	-	-	-	-	-	.64	3.00	-	3.50	-	-
Non-poisonous potato bug destroyer,	-	-	-	-	-	-	-	-	-	-	-	-	68.20	-	1.38	1.50
Tobacco liquor,	37.71	-	-	-	-	-	-	2.12	-	-	-	-	3.07	6.55	.23	-
Tobacco liquor,	40.89	-	-	-	-	-	-	.53	-	-	-	-	1.47	16.34	.01	-
Tobacco liquor,	-	-	-	-	-	-	-	4.68	-	-	-	-	-	-	-	-
Nicotina,	10.00	-	-	-	-	-	-	-	-	-	-	-	4.45	9.15	-	2.12
Hellebore,	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2.34
Hellebore,	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	38.12
Peroxide of silicate,	1.65	.57	.33	-	-	-	-	-	-	-	49.66	-	41.18	-	-	2.31

Compilation of Analyses of Fodder Articles and Dairy Products, made at Amherst, Mass., 1868–1905.[1]

E. B. HOLLAND AND P. H. SMITH.

A. Composition and Digestibility of Fodder Articles.
- I. — Green fodders.
  - (*a*) Meadow grasses and millets.
  - (*b*) Cereal fodders.
  - (*c*) Legumes.
  - (*d*) Mixed and miscellaneous.
- II. — Silage.
- III. — Hay and dry, coarse fodders.
  - (*a*) Meadow grasses and millets.
  - (*b*) Cereal fodders.
  - (*c*) Legumes.
  - (*d*) Straw.
  - (*e*) Mixed and miscellaneous.
- IV. — Vegetables, fruits, etc.
- V. — Concentrated feeds.
  - (*a*) Protein.
  - (*b*) Starchy.
  - (*c*) Poultry.
- VI. — Dairy products.

B. Fertilizer Ingredients of Fodder Articles. (For classification, see A and C.)

C. Analyses of Dairy Products.

[1] Part III. of the report of Department of Foods and Feeding.

A. Composition and Digestibility of Fodder Articles.

[Figures equal percentages or pounds in 100.]

Group	Name.	Number of Analyses.	Composition. Water.	Composition. Ash.	Composition. Protein.	Composition. Fibre.	Composition. Nitrogen-free Extract.	Composition. Fat.	Digestibility. Protein.	Digestibility. Fibre.	Digestibility. Nitrogen-free Extract.	Digestibility. Fat.
	I. — Green Fodders.											
	(a) Meadow Grasses and Millets.											
	Johnson grass (*Andropogon halepensis*),	1	75	1.4	1.2	8.9	13.2	0.3	–	–	–	–
	Orchard grass (*Dactylis glomerata*),	7	70	2.1	2.9	10.4	13.7	0.9	–	–	–	–
	Tall oat grass (*Arrhenatherum elatius*),	4	70	1.6	2.3	10.8	14.7	0.6	–	–	–	–
Fox-tail millets.	Common millet (*Chætochloa Italica*),	16	80	1.0	1.5	6.5	10.5	0.5	0.9	4.6	7.0	0.31[1]
Fox-tail millets.	Canary bird seed millet (*C. Italica*),	1	80	1.6	1.0	7.1	10.0	0.3	–	–	–	–
Fox-tail millets.	Early harvest millet (*C. Italica*),	1	80	1.4	1.1	7.4	9.7	0.4	–	–	–	–
Fox-tail millets.	Golden millet (*C. Italica*),	1	80	1.2	0.8	7.0	10.7	0.3	–	–	–	–
Fox-tail millets.	Hungarian grass (*C. Italica*),	3	80	1.4	1.9	5.8	10.5	0.4	1.2	4.1	7.0	0.2
Fox-tail millets.	Japanese millet (*C. Italica*),	12	80	1.2	1.7	6.2	10.5	0.4	0.9	3.8	7.0	0.3
Broom-corn millets.	Millet (*Panicum miliaceum*),	1	80	1.1	1.1	5.3	11.7	0.8	–	–	–	–
Broom-corn millets.	Broom-corn millet (*P. miliaceum*),	1	80	1.2	1.3	6.4	10.7	0.4	–	–	–	–
Broom-corn millets.	Hog millet (*P. miliaceum*),	1	80	1.4	1.5	6.5	10.2	0.4	–	–	–	–
Broom-corn millets.	Japanese broom-corn millet (*P. miliaceum*),	2	80	1.2	0.9	6.2	11.4	0.3	–	–	–	–

[1] Same coefficients used as for Hungarian grass.

A. COMPOSITION AND DIGESTIBILITY OF FODDER ARTICLES — *Continued.*

Name.	Number of Analyses.	Composition.						Digestibility.			
		Water.	Ash.	Protein.	Fibre.	Nitrogen-free Extract.	Fat.	Protein.	Fibre.	Nitrogen-free Extract.	Fat.
I. — GREEN FODDERS — *Con.*											
(*a*) *Meadow Grasses and Millets* — Con.											
Barnyard millet (*Panicum crus-galli*),	8	80	1.7	1.9	6.6	9.4	0.4	1.2	4.8	6.7	0.2
Pearl millet (*Pennisetum spicatum*),	1	80	1.4	1.4	6.9	10.1	0.2	-	-	-	-
Japanese millet (variety uncertain),	3	80	1.1	1.2	7.1	10.2	0.4	0.6	4.4	6.8	0.3
(*b*) *Cereal Fodders.*											
Barley,	1	75	2.1	3.2	9.4	9.6	0.7	2.3	5.7	6.8	0.4
Barley in milk,	1	75	1.2	2.6	7.3	13.2	0.7	1.8	4.1	9.8	0.3
Corn fodder,	48	80	1.0	1.6	4.7	12.3	0.4	1.0	3.0	9.3	0.3
Sweet corn stover,	2	80	1.2	1.4	4.9	12.0	0.5	0.7	2.8	8.8	0.4 [1]
Oats (stage uncertain),	6	75	2.0	3.5	7.5	11.2	0.8	2.6	4.1	6.9	0.6 [2]
Oats in bloom,	1	75	1.7	1.6	1.9	12.0	0.7	1.1	5.0	7.4	0.5 [2]
Oats in milk,	1	75	1.5	2.7	8.6	11.5	0.7	2.0	4.7	7.1	0.5 [2]
Oats, ripe,	1	70	1.9	1.8	10.9	14.6	0.8	-	-	-	-
Rye,	2	75	1.4	1.9	8.0	13.2	0.5	1.5	6.4	9.4	0.4
Winter rye in bloom,	1	75	1.6	2.7	8.3	11.8	0.6	2.1	6.6	8.4	0.4

(c) *Legumes.*											
Alfalfa (*Medicago sativa*),	6	80	1.6	2.7	6.2	9.1	0.4	2.0	2.7	6.6	0.2
Horse bean (*Faba vulgaris*),	1	85	0.9	2.5	4.3	6.9	0.4	-	-	-	-
Soy bean (*Glycine hispida*),	14	80	2.1	3.5	5.4	8.1	0.9	2.7	2.4	6.2	0.5[3]
Soy bean (early white),	4	80	2.6	3.4	4.5	9.0	0.5	2.7	2.0	6.9	0.3
Soy bean (medium green),	16	80	2.2	4.1	5.3	7.8	0.6	3.2	2.4	6.0	0.3
Soy bean (medium green), in bud,	1	80	2.5	4.2	5.5	7.3	0.5	3.3	2.8	5.3	0.3
Soy bean (medium green), in blossom,	5	80	2.3	4.0	5.5	7.7	0.5	3.1	2.6	5.5	0.3
Soy bean (medium green), in pod,	9	78	2.3	4.5	5.9	8.6	0.7	3.5	2.7	6.6	0.4
Soy bean (medium black),	2	80	2.5	3.8	4.7	8.0	1.0	3.0	2.1	6.2	0.6
Soy bean (late),	4	80	2.6	4.6	4.2	8.0	0.6	3.6	1.9	6.2	0.3
Clover, alsike (*Trifolium hybridum*),	8	80	2.3	3.3	5.4	8.5	0.5	-	-	-	-
Clover, crimson (*T. incarnatum*),	2	80	2.8	3.1	6.0	7.6	0.5	2.4	3.4	5.6	0.3
Clover, mammoth red (*T. medium*),	4	80	1.9	3.0	5.8	8.9	0.4	-	-	-	-
Clover, medium red (*T. pratense*),	13	80	1.8	3.1	5.7	8.8	0.6	2.0	3.0	6.3	0.4
Clover, medium red, in bud,	2	80	2.1	3.6	4.7	9.0	0.6	2.4	2.5	6.6	0.4[4]
Clover, medium red, in blossom,	3	79	1.9	3.5	6.0	9.0	0.6	-	-	-	-
Clover, medium red, seeding,	2	75	2.3	3.8	7.2	11.0	0.7	2.4	3.7	7.2	0.4
Sweet clover (*Melilotus alba*),	4	80	1.9	3.8	6.3	7.4	0.6	-	-	-	-
Cow pea (*Vigna catjang*),	12	85	2.0	2.8	3.5	6.3	0.4	2.1	2.1	5.1	0.2[5]

[1] Same coefficients used as for corn fodder.
[2] Same coefficients applied to oats in several stages of growth.
[3] Same coefficients applied to all soy beans except to medium green varieties in different stages of growth.
[4] Coefficients taken from the German.
[5] Same coefficients applied to all cow peas.

A. COMPOSITION AND DIGESTIBILITY OF FODDER ARTICLES — *Continued.*

Name.	Number of Analyses.	Composition.						Digestibility.			
		Water.	Ash.	Protein.	Fibre.	Nitrogen-free Extract.	Fat.	Protein.	Fibre.	Nitrogen-free Extract.	Fat.
I.—GREEN FODDERS—*Con.*											
(*c*) *Legumes*—Con.											
Cow pea, black,	4	85	2.3	3.1	3.4	5.9	0.3	2.4	2.0	4.8	0.2
Cow pea, Whip-poor-will,	5	85	1.9	2.5	3.7	6.6	0.3	1.9	2.2	5.3	0.2
Canada beauty pea (*Pisum arvense*),	1	85	1.2	2.4	4.4	6.6	0.4	-	-	-	-
Canada field pea (*P. arvense*),	8	85	1.3	3.2	4.3	5.8	0.4	-	-	-	-
Canada field pea (*P. arvense*), in bud,	2	85	1.1	3.2	4.1	6.1	0.5	2.6	2.5	4.3	0.3 [1]
Canada field pea (*P. arvense*), in blossom,	3	87	1.2	2.8	3.8	4.8	0.4	2.3	1.7	3.6	0.2
Canada field pea (*P. arvense*), in pod,	2	84	1.2	2.3	4.8	6.3	0.4	1.9	2.2	4.8	0.2
English gray pea (*P. arvense*),	1	85	1.4	3.1	4.5	5.5	0.5	-	-	-	-
Prussian blue pea (*P. arvense*),	1	85	1.3	2.8	4.5	5.9	0.5	-	-	-	-
Flat pea (*Lathyrus sylvestris wagneri*),	2	85	1.3	4.4	3.7	5.0	0.6	-	-	-	-
Sainfoin (*Onobrychis sativa*),	1	75	2.1	4.4	6.0	11.6	0.9	-	-	-	-
Serradella (*Ornithopus sativus*),	3	85	1.6	2.2	4.4	6.5	0.3	-	-	-	-
Sulla (*Hedysarum coronarium*),	2	75	2.3	4.3	5.2	12.5	0.7	-	-	-	-
Spring vetch (*Vicia sativa*),	4	85	1.4	2.7	4.5	6.1	0.4	1.9	2.0	4.6	0.2

Winter or sand vetch (*Vicia villosa*),	7	85	2.1	3.4	4.4	4.7	0.4	2.8	2.8	3.6	0.3
Winter or sand vetch (*V. villosa*), in bud,	2	86	2.4	3.3	3.5	4.4	0.4	–	–	–	–
Winter or sand vetch (*V. villosa*), in blossom,	4	82	2.5	4.2	5.5	5.4	0.4	3.5	3.5	4.2	0.3
Kidney vetch (*Anthyllis vulneraria*),	1	85	2.0	2.8	2.3	7.4	0.5	–	–	–	–
(d) Mixed and Miscellaneous.											
Barley and peas,	1	80	1.6	2.8	6.8	8.2	0.6	2.1	3.5	5.6	0.4
Barley and vetch,	2	80	1.2	2.8	6.5	9.0	0.5	2.1	3.4	6.1	0.3 [2]
Corn and soy bean,	3	80	1.5	2.6	5.0	10.4	0.5	–	–	–	–
Corn and cow peas,	1	80	1.8	2.1	5.3	10.4	0.4	–	–	–	–
Sweet corn and cow peas,	1	80	1.5	1.8	4.8	11.4	0.5	–	–	–	–
Millet and peas,	1	80	1.8	2.4	7.5	8.0	0.3	–	–	–	–
Tall oat grass and alsike clover,	2	80	1.5	2.7	5.8	9.5	0.5	–	–	–	–
Orchard grass and alsike clover,	1	80	1.5	2.4	6.5	9.0	0.7	–	–	–	–
Peas and oats,	4	80	1.7	2.9	6.0	8.8	0.6	2.1	3.8	6.3	0.4
Sorghum and cow peas,	1	80	1.6	1.6	6.5	9.9	0.4	–	–	–	–
Vetch and oats (1–1),	3	80	1.8	3.0	6.3	8.4	0.5	2.3	4.3	5.7	0.2
Vetch and oats (1–4),	1	80	1.8	2.7	6.0	8.8	0.7	–	–	–	–
Wheat and vetch,	4	80	1.6	3.4	6.4	8.1	0.5	2.6	4.4	5.9	0.3
Apple pomace,	6	83	0.6	1.0	2.9	11.6	0.9	–	1.9	9.9	0.4
Sugar-beet pulp,	1	90	0.1	1.4	2.5	5.9	0.1	0.9	2.1	5.0	–
Cabbage waste,	1	82	4.9	3.6	2.6	6.6	0.3	–	–	–	–

[1] Same coefficients applied to Canada field peas in blossom and in pod.

[2] Same coefficients used as for barley and peas.

A. Composition and Digestibility of Fodder Articles — *Continued.*

Name.	Number of Analyses.	Composition.						Digestibility.			
		Water.	Ash.	Protein.	Fibre.	Nitrogen-free Extract.	Fat.	Protein.	Fibre.	Nitrogen-free Extract.	Fat.
I. — Green Fodders — *Con.*											
(*d*) *Mixed and Miscellaneous* — Con.											
Carrot tops,	1	80	2.8	4.2	2.7	9.9	0.4	–	–	–	–
Prickly comfrey (*Symphytum asperrimum*),	1	87	2.8	2.3	1.5	6.1	0.3	–	–	–	–
Purslane (*Portulaca oleracea*),	1	91	1.5	2.3	1.6	3.4	0.2	–	–	–	–
Dwarf Essex rape (*Brassica napus*),	1	85	2.4	1.9	2.9	7.2	0.6	1.7	2.5	6.6	0.3 [1]
Summer rape (*B. napus*),	1	85	2.8	2.1	2.7	6.9	0.5	1.9	2.3	6.3	0.2
Winter rape (*B. napus*),	1	85	3.3	2.3	1.8	7.1	0.5	2.0	1.6	6.5	0.2
Sorghum (*Andropogon sorghum*),	7	80	1.3	1.7	5.5	11.1	0.4	–	–	–	–
Spurry (*Spergula arvensis*),	1	72	2.6	2.9	7.0	15.4	0.1	–	–	–	–
Teosinte (*Euchlæna Mexicana*),	2	70	2.3	2.3	9.4	15.6	0.4	–	–	–	–
II. — Silage.											
Apple pomace,	1	85	0.6	1.2	3.3	8.8	1.1	–	2.2	7.5	0.5 [2]
Corn,	47	80	1.1	1.7	5.4	11.1	0.7	0.8	3.5	7.7	0.5
Corn and soy bean,	6	76	2.3	2.7	7.3	10.9	0.8	1.7	4.5	8.5	0.7
Millet,	3	74	2.4	1.7	7.5	13.6	0.8	–	–	–	–
Millet and soy bean,	9	79	2.8	2.8	7.2	7.2	1.0	1.6	5.0	4.2	0.7

III. — Hay and Dry Coarse Fodders.											
(a) Meadow Grasses and Millets.											
Canada blue-grass (*Poa compressa*),	1	14	4.8	5.9	31.3	42.1	0.9	2.5	22.2	26.5	0.3
Kentucky blue-grass (*Poa pratensis*),	3	14	6.4	7.7	30.5	39.7	1.7	4.4	19.2	21.0	0.7
Canada hay,	4	14	4.6	6.1	28.1	45.1	2.1	-	-	-	-
English hay (mixed grasses),	102	14	5.3	7.9	27.7	42.8	2.3	3.7	18.0	25.3	1.0
Fermented hay,	1	14	6.3	8.4	25.4	43.7	2.2	-	-	-	-
Meadow fescue (*Festuca elatior pratensis*),	7	14	7.1	5.8	32.2	39.3	1.6	3.0	21.6	23.2	0.9
Millets. Barnyard grass (*Panicum crus-galli*),	1	14	8.6	13.1	29.0	33.6	1.7	-	-	-	-
Millets. Barnyard millet (*P. crus-galli*),	8	14	7.3	8.2	28.4	40.4	1.7	5.2	17.6	21.0	0.8
Millets. Hungarian grass (*Chaetochloa Italica*),	3	14	6.3	8.4	24.6	45.0	1.7	5.0	16.7	30.2	1.1
Orchard grass (*Dactylis glomerata*),	7	14	5.9	8.3	29.9	39.3	2.6	5.0	18.2	21.6	1.4
Tall oat grass (*Arrhenatherum elatius*),	4	14	4.6	6.4	30.9	42.1	1.9	3.3	17.0	24.4	1.1
Red-top (*Agrostis alba vulgaris*),	6	14	4.6	6.5	28.5	44.9	1.5	4.0	17.4	27.8	0.8
Red-top (*A. alba vulgaris*), early cut,	1	14	4.3	5.8	30.9	43.3	1.7	-	-	-	-
Red-top (*A. alba vulgaris*), late cut,	1	14	4.1	6.0	31.0	43.2	1.7	-	-	-	-
Rowen,	29	14	6.4	11.4	23.9	41.3	3.0	7.9	15.8	26.4	1.4
Italian rye grass (*Lolium Italicum*),	4	14	6.4	7.1	28.6	42.2	1.6	-	-	-	-
Perennial rye grass (*Lolium perenne*),	4	14	7.9	10.1	25.4	40.5	2.1	-	-	-	-

[1] Same coefficients applied to all varieties of rape.

[2] Same coefficients used as for fresh apple pomace.

A. Composition and Digestibility of Fodder Articles — *Continued.*

	Name.	Number of Analyses.	Composition.						Digestibility.			
			Water.	Ash.	Protein.	Fibre.	Nitrogen-free Extract.	Fat.	Protein.	Fibre.	Nitrogen-free Extract.	Fat.
	III. — Hay and Dry Coarse Fodders — *Con.*											
	(*a*) *Meadow Grasses and Millets* — Con.											
Salt hays.	Black grass (*Juncus Gerardi*),	3	16	7.4	7.0	24.3	43.1	2.2	4.1	14.3	22.4	1.0
	Branch grass (*Distichlis spicata*),	2	16	7.6	6.8	22.4	45.1	2.1	3.8	12.1	22.1	0.7
	Flat sage (*Spartina stricta maritima var?*),	1	16	8.2	6.6	25.0	41.8	2.4	3.4	15.0	23.0	0.9
	Fox grass (*Spartina patens*),	2	16	5.8	6.7	22.5	46.9	2.1	4.0	11.9	24.9	0.8
	High-grown salt hay (largely *Spartina patens*),	1	16	7.0	6.3	22.2	46.4	2.1	3.8	11.8	24.6	0.8
	Cove mixture (black grass and red-top),	1	16	6.0	7.4	23.2	45.6	1.8	3.6	13.9	24.2	0.7
	Mixed salt hay (largely fox grass and branch grass),	1	16	8.4	5.5	22.5	45.5	2.1	2.3	13.1	23.7	0.6
	Salt hay (variety uncertain),	2	16	4.3	3.4	24.0	49.8	2.5	–	–	–	–
	Swamp or swale hay,	2	14	5.8	7.1	26.7	44.5	1.9	2.4	8.8	20.5	0.8
	Timothy (*Phleum pratense*),	8	14	4.2	8.4	28.1	43.4	1.9	4.0	14.1	26.9	1.0
	Timothy (*P. pratense*), early cut,	1	14	4.0	5.7	31.0	43.5	1.8	3.2	17.7	27.4	0.9
	Timothy (*P. pratense*), late cut,	1	14	3.9	5.2	29.7	45.2	2.0	2.2	13.7	26.7	1.0
	White-top (*Agrostis vulgaris var.*),	1	14	6.0	11.2	24.4	41.5	2.9	-	-	-	-

(b) Cereal Fodders.											
Corn stover, from field,	44	40	3.9	4.6	20.6	30.1	0.8	1.7	13.2	17.8	0.5
Corn stover, very dry,	44	20	5.2	6.1	27.4	40.2	1.1	2.2	17.5	23.7	0.7
Oats,	6	15	6.9	11.7	25.5	38.3	2.6	6.2	13.0	21.1	1.6
(c) Legumes.											
Alsike clover,	8	15	9.7	14.0	23.1	36.1	2.1	9.2	11.6	23.8	8.0
Mammoth red clover,	4	15	8.2	13.1	24.4	37.6	1.7	-	-	-	-
Medium red clover,	13	15	7.6	13.2	24.2	37.4	2.6	7.7	13.1	23.9	1.4
(d) Straw.											
Barley,	2	15	4.8	6.5	32.2	39.0	2.5	1.3	18.0	21.1	1.1 [1]
Horse bean,	1	15	8.1	8.3	35.2	32.1	1.3	-	-	-	-
Soy bean,	3	15	6.1	4.7	36.1	36.3	1.8	2.4	13.7	24.0	1.1 [1]
Millet (*Chætochloa Italica*),	1	15	5.3	3.6	35.2	39.5	1.4	-	-	-	-
Millet (*Panicum crus-galli*),	1	15	4.6	5.2	30.4	42.7	2.1	-	-	-	-
Millet (*P. miliaceum*),	1	15	5.2	3.3	35.9	38.1	2.5	-	-	-	-
Millet (variety uncertain),	1	15	5.8	4.2	35.5	38.3	1.2	-	-	-	-
Wheat,	1	15	4.1	6.2	30.5	42.8	1.4	0.7	15.9	16.3	0.4 [1]
(e) Mixed and Miscellaneous.											
Hairy lotus,	2	15	7.0	12.6	16.8	46.1	2.5	-	-	-	-
Oat grass and alsike clover,	2	15	6.5	11.6	24.5	40.1	2.3	-	-	-	-
Orchard grass and alsike clover,	1	15	6.6	10.1	27.6	38.3	2.4	-	-	-	-

[1] Coefficients taken from the German.

A. Composition and Digestibility of Fodder Articles — *Continued.*

Name.	Number of Analyses.	Composition.						Digestibility.			
		Water.	Ash.	Protein.	Fibre.	Nitrogen-free Extract.	Fat.	Protein.	Fibre.	Nitrogen-free Extract.	Fat.
III.—Hay and Dry Coarse Fodders—*Con.*											
(e) *Mixed and Miscellaneous*—Con.											
Peas and oats,	4	15	7.2	12.2	25.5	37.5	2.6	8.9	14.8	22.9	1.5
Vetch and oats (1-1),	3	15	7.4	12.8	26.7	35.8	2.3	8.3	13.1	21.1	1.4
Wheat and vetch,	4	15	6.8	14.5	27.2	34.4	2.1	10.7	17.7	23.4	1.3
White daisy,	1	15	6.0	6.6	30.7	39.7	2.0	-	-	-	-
IV.—Vegetables, Fruits, etc.											
Apples,	2	78	0.7	1.0	1.5	18.3	0.5	-	-	-	-
Artichokes,	1	78	1.1	2.9	0.9	16.9	0.2	-	-	-	-
Beets, red,	7	88	1.1	1.5	0.7	8.6	0.1	-	-	-	-
Sugar beets,	13	86	0.9	1.6	0.9	10.5	0.1	1.5	0.9	10.5	0.1
Yellow fodder beets,	4	89	1.0	1.3	1.0	7.5	0.2	1.0	-	4.2	-
Cabbages,	1	90	0.8	2.6	0.9	5.5	0.2	-	-	-	-
Carrots,	5	89	0.9	1.0	1.1	7.8	0.2	-	-	-	-
Cranberries,	1	89	0.2	0.5	1.2	8.5	0.6	-	-	-	-
Mangolds,	5	88	1.2	1.4	0.8	8.5	0.1	1.0	0.3	7.7	-

Parsnips,	1	80	1.5	1.3	1.5	15.0	0.7	-	-	-	-
Potatoes,	22	80	0.9	2.1	0.5	16.4	0.1	1.0	-	14.8	-
Potatoes,	93	80	-	-	-	14.3 [1]	-	-	-	-	-
Ruta-bagas,	3	89	1.1	1.2	1.3	7.2	0.2	1.0	1.0	6.8	0.2
Japanese radish,	1	93	0.7	0.5	0.7	5.0	0.1	-	-	-	-
Turnips,	5	90	0.9	1.5	1.2	6.6	0.2	1.4	1.2	6.3	0.2
V.—CONCENTRATED FEEDS.											
(a) Protein.											
Horse beans,	1	14	3.8	25.8	7.0	48.6	0.8	-	-	-	-
Red adzinki beans,	2	14	3.6	21.0	4.0	56.7	0.7	-	-	-	-
Saddle beans,	1	14	5.3	13.0	4.1	49.4	14.2	-	-	-	-
Soy bean,	5	14	5.0	31.2	4.7	28.4	16.7	-	-	-	-
Soy bean (medium green),	2	14	4.6	35.6	3.9	24.6	17.3	32.4	-	19.9	16.1
Blood meal, Armour's edible,	3	11	3.1	84.3	-	1.2	0.4	70.8	-	-	-
Brewers' dried grains,	9	10	3.4	23.5	12.0	45.6	5.5	19.0	5.9	26.0	4.9
Brewers' wet grains,	1	77	0.7	6.7	3.8	9.8	2.0	5.3	2.0	5.7	1.8
Buckwheat feed,	2	10	3.2	15.9	22.0	41.8	4.1	-	-	-	-
Buckwheat middlings,	3	10	4.7	26.7	6.8	41.6	7.2	22.7	1.1	37.0	6.4
Cocoanut meal,	3	9	4.7	20.4	11.0	40.6	4.3	-	-	-	-
Cotton-seed meal,	319	7	6.6	15.3	6.3	21.6	10.2	38.1	2.2	19.2	9.6
Cotton-seed meal (low grade),	32	8	4.6	24.9	18.0	37.0	7.5	18.2	6.8	25.2	6.8

[1] Starch.

A. Composition and Digestibility of Fodder Articles — *Continued.*

Name.	Number of Analyses.	Composition. Water.	Composition. Ash.	Composition. Protein.	Composition. Fibre.	Composition. Nitrogen-free Extract.	Composition. Fat.	Digestibility. Protein.	Digestibility. Fibre.	Digestibility. Nitrogen-free Extract.	Digestibility. Fat.
V. — Concentrated Feeds — *Con.*											
(*a*) *Protein* — Con.											
Dairy feed, H-O,	11	8.0	3.3	18.1	12.9	53.5	4.2	13.8	4.5	38.5	3.5
Distillers' dried grains, largely from corn,	56	8.0	1.7	31.7	12.3	34.2	12.1	23.1	11.7	27.7	11.5
Gluten feed,	192	8.5	1.7	26.2	7.2	53.3	3.1	22.3	5.5	47.4	2.6
Gluten flour, wheat,	1	5.5	0.4	84.8	0.2	8.1	1.0	-	-	-	-
Gluten meal, wheat,	2	8.0	0.9	39.8	0.8	48.9	1.6	-	-	-	-
Gluten meal,	138	9.5	1.0	36.0	2.1	49.1	2.3	31.7	-	43.2	2.1
King gluten meal (old process),	6	7.0	1.2	33.3	1.8	43.6	13.1	-	-	-	-
Germ oil meal,	13	9.0	2.7	22.7	9.3	45.9	10.4	15.7	-	37.2	10.1
Flaxseed meal,	2	7.0	3.5	23.5	5.5	23.3	37.2	-	-	-	-
Linseed meal (new process),	52	9.0	5.5	37.5	8.9	36.4	2.7	31.5	6.6	29.1	2.4
Linseed meal (old process),	113	8.5	5.2	34.3	8.6	36.5	6.9	30.5	4.9	28.5	6.1
Malt sprouts,	17	11.0	5.6	26.4	12.6	43.0	1.4	20.1	12.5	36.6	1.2
Bibby's dairy cake,	4	10.0	7.7	19.7	8.6	44.9	9.1	13.0	4.0	36.4	8.4
Blomo feed,	4	20.0	7.6	13.0	14.6	44.2	0.6	8.2	8.9	33.6	0.1

Holstein sugar feed,	1	8.0	6.7	12.6	10.0	60.0	2.7	8.3	4.4	48.6	2.4
Macon sugar feed,	2	6.0	6.6	14.0	10.2	61.6	1.6	8.3	4.5	50.5	1.3
Sucrene dairy feed,	8	10.0	6.3	16.6	11.7	52.1	3.3	10.1	8.4	38.0	3.1
Sucrene oil meal,	3	9.0	5.7	23.2	10.7	48.6	2.8	-	-	-	-
Oat middlings, fine,	4	9.0	2.3	15.8	2.4	64.3	6.2	12.8	1.2	61.7	5.8
Pea meal,	1	10.0	2.6	18.9	17.5	49.4	1.6	15.7	4.6	46.4	0.9
Peanut meal,	1	8.0	4.0	49.0	3.5	24.7	10.8	44.6	0.8	22.7	9.6
Proteina,	4	8.0	2.5	21.8	10.0	51.1	6.6	-	-	-	-
Rye feed,	15	11.0	3.2	14.7	3.8	64.6	2.7	11.8	-	56.8	2.4
Wheat middlings (flour),	106	10.0	3.2	19.2	3.2	59.6	4.8	16.9	1.2	52.4	4.1
Wheat middlings (standard),	308	10.0	4.3	17.9	7.0	55.8	5.0	13.8	2.1	43.5	4.4
Wheat mixed feed, bran and middlings,	732	10.0	5.3	17.0	8.2	55.0	4.5	13.2	5.1	42.4	3.9
Wheat mixed feed, adulterated,	7	10.0	4.3	12.3	15.5	54.6	3.3	7.7	4.3	38.8	3.0
Wheat bran,	379	10.0	6.2	16.3	10.0	53.1	4.4	12.6	3.9	37.7	2.8
Wheat bran (spring),	4	10.0	5.8	16.1	10.5	52.6	5.0	12.2	4.6	38.9	3.2
Wheat bran (winter),	3	10.0	6.2	15.3	8.6	57.0	2.9	11.8	2.3	37.1	1.9
(b) Starchy.											
Bakery refuse,	1	13.0	10.1	8.0	0.3	63.0	5.6	-	-	-	-
Barley,	6	12.0	2.4	11.2	5.7	66.8	1.9	7.8	2.9	61.5	1.7 [1]
Broom-corn seed,	2	14.0	2.1	9.6	7.0	63.8	3.5	-	-	-	-
Buckwheat,	1	12.0	1.9	9.9	10.3	63.5	2.4	-	-	-	-

[1] Digestion coefficients taken from the German.

A. Composition and Digestibility of Fodder Articles — *Continued.*

Name.	Number of Analyses.	Composition. Water.	Composition. Ash.	Composition. Protein.	Composition. Fibre.	Composition. Nitrogen-free Extract.	Composition. Fat.	Digestibility. Protein.	Digestibility. Fibre.	Digestibility. Nitrogen-free Extract.	Digestibility. Fat.
V. — Concentrated Feeds — *Con.*											
(*b*) *Starchy* — Con.											
Cassava starch refuse,	1	12	1.6	0.8	6.1	78.8	0.7	–	–	–	–
Cerealine,	4	11	2.6	11.1	4.9	62.7	7.7	8.9	4.0	59.6	6.2
Cocoa dust,	1	7	6.3	14.4	5.5	42.7	24.1	–	–	–	–
Cocoa shells,	1	5	8.4	18.0	15.9	50.9	1.8	–	–	–	–
Cocoanut meat,	1	1	0.8	9.9	7.5	15.3	65.5	–	–	–	–
Corn bran,	2	11	2.0	10.8	12.4	59.8	4.0	5.8	7.3	46.0	3.1
Corn cobs,	6	8	1.3	2.7	31.3	56.2	0.5	0.5	17.8	27.0	–
Corn and cob meal,	38	11	1.4	8.9	6.7	68.4	3.6	5.0	3.1	60.2	3.0
Corn kernels,	93	11	1.3	10.2	2.0	71.6	3.9	–	–	–	–
Corn meal,	93	14	1.3	9.8	1.9	69.2	3.8	6.3	–	63.7	3.5
Sweet corn kernels,	3	11	1.9	12.5	2.4	64.9	7.3	–	–	–	–
Corn and oat feed,	48	10	3.0	9.1	9.9	64.8	3.2	–	–	–	–
Corn and oat feed (Victor),	39	10	3.5	8.6	11.3	62.9	3.7	6.1	5.4	52.2	3.2
Corn, oat and barley feed,	8	10	3.1	11.4	8.3	62.4	4.8	–	–	–	–

Corn, oat and barley feed (Schumacher's),	14	8	4.0	11.3	11.8	60.3	4.6	–	–	–	–
Corn screenings,	1	11	2.1	7.4	2.9	72.6	4.0	–	–	–	–
Cotton hulls,	5	11	2.6	5.3	39.7	39.0	2.4	–	15.9	16.0	2.1
Cotton-hull bran,	1	11	1.9	2.3	35.0	48.7	1.1	–	–	–	–
Cotton-seed feed,	4	11	3.1	10.5	36.0	35.9	3.5	5.4	16.6	19.8	3.0
Dairy feed (Quaker),	33	8	4.6	13.2	16.8	54.3	3.1	9.2	9.2	32.0	2.3
Flaxseed screenings,	1	7	5.4	15.7	16.5	44.5	10.9	–	–	–	–
Hominy meal,	120	11	2.5	10.4	4.2	64.1	7.8	6.8	2.8	57.0	7.2
Horse feed (H-O),	13	9	3.1	12.6	9.8	62.0	3.5	8.8	5.5	51.5	2.8
Maizeline,	1	5	2.7	10.0	7.9	66.0	8.4	–	–	–	–
Mellen's food refuse,	1	7	3.9	11.4	7.1	67.2	3.4	–	–	–	–
Millet seed,	4	12	2.6	11.1	7.7	62.9	3.7	–	–	–	–
Barnyard millet seed,	1	11	3.3	12.2	7.6	60.3	5.6	–	–	–	–
Molasses, Porto Rico,	2	24	6.8	3.1	–	66.1	–	–	–	–	–
Dried molasses beet pulp,	3	8	5.4	9.5	15.4	61.3	0.4	6.1	12.9	55.8	–
Oat kernels,	9	11	3.0	12.4	8.5	60.4	4.7	10.7	2.6	47.7	3.8[1]
Oats, ground,	9	12	3.0	12.3	8.4	59.7	4.6	10.1	1.2	51.3	3.7[1]
Oat feed,	110	7	5.3	8.0	21.5	55.3	2.9	5.5	7.1	28.2	1.5
Oat feed (low grade),	17	7	5.5	5.1	26.4	54.4	1.6	3.2	8.4	18.0	1.5
Oat feed, Canada,	2	7	5.4	13.2	24.8	44.7	4.9	9.1	8.2	22.8	4.3
Parson's "six-dollar" feed,	1	11	7.9	10.0	17.9	51.1	2.1	5.9	8.4	32.7	1.7

[1] Coefficients obtained from digestion experiments with horses.

A. Composition and Digestibility of Fodder Articles — *Concluded.*

Name.	Number of Analyses.	Composition.						Digestibility.			
		Water.	Ash.	Protein.	Fibre.	Nitrogen-free Extract.	Fat.	Protein.	Fibre.	Nitrogen-free Extract.	Fat.
V.—Concentrated Feeds—*Con.*											
(*b*) *Starchy*—Con.											
Pea bran,	2	11	2.7	10.0	39.7	35.6	1.0	-	-	-	-
Peanut feed, largely husks,	2	10	2.6	8.9	56.4	16.6	5.5	6.3	6.2	8.1	5.0
Peanut husks,	1	13	1.2	5.0	66.0	13.1	1.7	-	-	-	-
Peanut shells,	2	7	2.8	7.1	62.2	19.0	1.9	-	-	-	-
Rice, cleaned,	1	11	0.3	8.5	0.1	79.8	0.3	-	-	-	-
Rice bran,	2	11	12.7	6.8	20.6	42.8	6.1	4.3	6.0	33.4	5.4
Rice meal,	2	11	8.2	11.8	5.3	50.8	12.9	7.3	-	46.7	11.7
Rye middlings,	1	11	3.6	11.7	3.3	65.4	5.0	-	-	-	-
Speltz,	1	8	3.9	11.5	11.1	62.9	2.2	-	-	-	-
Starch refuse,	2	12	1.8	4.8	3.8	76.3	1.3	-	-	-	-
Wheat kernels,	11	11	1.8	12.4	2.7	70.2	1.9	-	-	-	-
Wheat flour,	2	12	0.4	9.9	0.1	76.8	0.8	-	-	-	-

(c) Poultry.											
American poultry food,	14	8	2.9	13.1	6.5	63.6	5.9	-	-	-	-
Cut bone,	1	26	21.5	20.7	-	0.2	31.6	-	-	-	-
Raw ground bone,	1	8	64.4	23.9	-	3.4	0.3	-	-	-	-
Cut clover,	2	10	6.8	17.9	20.5	41.8	3.0	-	-	-	-
H-O poultry food,	3	9	2.7	17.4	4.4	60.2	5.3	-	-	-	-
Meat and bone meal,	37	6	37.4	39.5	-	6.3	10.8	-	-	-	-
Meat scrap,	11	9	17.6	50.8	-	4.5	18.1	-	-	-	-
Mutton scrap,	1	7	33.1	39.9	-	5.3	14.7	-	-	-	-
Granulated milk,	1	10	26.5	35.9	-	18.1	9.6	-	-	-	-

B. Fertilizer Ingredients of Fodder Articles.[1]

[Figures equal percentages or pounds in 100.]

	Number of Analyses.	Water.	Nitrogen.	Potash.	Phosphoric Acid.
1. — Green Fodders.					
(a) Meadow Grasses and Millets.					
Orchard grass,	4	70	0.43	0.56	0.13
Millet,	1	80	0.29	0.43	0.11
Barnyard millet,	3	80	0.30	0.67	0.10
Hungarian grass,	1	80	0.30	0.42	0.12
Japanese millet,	3	80	0.33	0.22	0.10
(b) Cereal Fodders.					
Corn fodder,	22	80	0.39	0.30	0.13
Oats,	3	75	0.72	0.56	0.19
Rye,	2	75	0.27	0.57	0.11
(c) Legumes.					
Alfalfa,	4	80	0.44	0.31	0.11
Horse bean,	1	85	0.41	0.21	0.05
Soy bean (early white),	1	80	0.57	0.55	0.13
Soy bean (medium green), average,	11	80	0.64	0.53	0.14
Soy bean (medium green), in bud,	1	80	0.66	0.58	0.15
Soy bean (medium green), in blossom,	5	80	0.64	0.60	0.13
Soy bean (medium green), in pod,	7	78	0.72	0.52	0.17
Soy bean (medium black),	1	80	0.70	0.50	0.16
Soy bean (late),	1	80	0.60	0.68	0.14
Alsike clover,	6	80	0.53	0.50	0.15
Mammoth red clover,	3	80	0.50	0.27 [2]	0.12
Medium red clover, average,	10	80	0.52	0.57	0.11
Medium red clover, in bud,	2	80	0.58	0.71	0.13
Medium red clover, in blossom,	3	79	0.51	0.58	0.12
Medium red clover, seeding,	2	75	0.61	0.65	0.13
Sweet clover,	1	80	0.43	0.40	0.12
White lupine,	1	85	0.45	0.26	0.05
Yellow lupine,	1	85	0.40	0.44	0.09

[1] Many of these analyses were made in earlier years by the Massachusetts State Experiment Station. The percentages of the several ingredients will vary considerably, depending upon the fertility of the soil, and especially upon the stage of growth of the plant. In the majority of cases the number of samples analyzed is too few to give a fair average. The figures, therefore, must be regarded as close approximations, rather than as representing absolutely the exact fertilizing ingredients of the different materials. (J. B. L.)

[2] Evidently below normal.

B. FERTILIZER INGREDIENTS OF FODDER ARTICLES — *Continued.*

	Number of Analyses.	Water.	Nitrogen.	Potash.	Phosphoric Acid.
I. — GREEN FODDERS — *Con.*					
(*c*) *Legumes* — Con.					
Canada field peas, average,	6	85	0.50	0.38	0.12
Canada field peas, in bud,	2	85	0.50	0.44	0.11
Canada field peas, in blossom,	2	87	0.45	0.32	0.11
Canada field peas, in pod,	2	84	0.52	0.37	0.13
Cow pea, average,	9	85	0.45	0.47	0.12
Black cow peas,	4	85	0.40	0.47	0.12
Whip-poor-will cow peas,	5	85	0.49	0.47	0.12
Flat pea,	1	85	0.75	0.32	0.10
Small pea,	1	85	0.40	0.31	0.09
Sainfoin,	1	75	0.68	0.57	0.20
Serradella,	2	85	0.36	0.37	0.12
Sulla,	2	75	0.68	0.58	0.12
Spring vetch,	1	85	0.36	0.45	0.10
Hairy or sand vetch, average,	5	85	0.55	0.51	0.13
Hairy or sand vetch, in bud,	2	86	0.52	0.54	0.12
Hairy or sand vetch, in blossom,	3	82	0.65	0.57	0.16
Kidney vetch,	1	85	0.44	0.28	0.08
Average for legumes,	–	–	0.53	0.44	0.12
(*d*) *Mixed and Miscellaneous.*					
Vetch and oats,	4	80	0.30 [1]	0.30	0.14
Apple pomace,	2	83	0.21	0.12	0.02
Carrot tops,	1	80	0.69	1.08	0.13
Prickly comfrey,	1	87	0.37	0.76	0.12
Common buckwheat,	1	85	0.44	0.54	0.09
Japanese buckwheat,	1	85	0.26	0.53	0.14
Silver-hull buckwheat,	1	85	0.29	0.39	0.14
Summer rape,	1	85	0.34	0.78	0.10
Sorghum,	8	80	0.26	0.29	0.11
Teosinte,	1	70	0.47	1.18	0.06
II. — SILAGE.					
Corn,	7	80	0.42	0.39	0.13
Corn and soy bean,	1	76	0.65	0.36	0.35 [2]
Millet,	3	74	0.26	0.62	0.14
Millet and soy bean,	5	79	0.42	0.44	0.11

[1] Too low; 0.43 nearer correct.

[2] Evidently too high.

B. FERTILIZER INGREDIENTS OF FODDER ARTICLES — *Continued.*

	Number of Analyses.	Water.	Nitrogen.	Potash.	Phosphoric Acid.
III. — HAY AND DRY COARSE FODDERS.					
(a) Meadow Grasses and Millets.					
Barnyard millet,	3	14	1.29	2.88	0.43
Hungarian grass,	1	14	1.29	1.79	0.52
Italian rye grass,	4	14	1.12	1.19	0.53
Kentucky blue-grass,	2	14	1.20	1.54	0.39
Meadow fescue,	6	14	0.93	1.98	0.37
Orchard grass,	4	14	1.23	1.60	0.38
Perennial rye grass,	2	14	1.16	1.47	0.53
Red-top,	4	14	1.07	0.95	0.33
Timothy,	3	14	1.20	1.42	0.33
English hay (mixed grasses),	13	14	1.34	1.61	0.32
Rowen,	13	14	1.72	1.58	0.48
Branch grass,	1	16	1.06	0.87	0.19
Fox grass,	1	16	1.18	0.95	0.18
Salt hay (variety uncertain),	1	16	1.05	0.64	0.23
(b) Cereal Fodders.					
Corn stover, from field,	17	40	0.69	0.92	0.20
Corn stover, very dry,	17	20	0.92	1.22	0.26
Oats,	3	15	2.45 [1]	1.90	0.65
(c) Legumes.					
Alsike clover,	6	15	2.26	2.10	0.63
Mammoth red clover,	3	15	2.14	1.16 [2]	0.52
Medium red clover,	10	15	2.21	2.42	0.47
(d) Straw.					
Barley,	2	15	0.95	2.03	0.19
Soy bean,	1	15	0.69	1.04	0.25
Millet,	1	15	0.68	1.73	0.18
(e) Mixed and Miscellaneous.					
Vetch and oats,	4	15	1.29 [3]	1.27	0.60
Broom corn waste (stalks),	1	10	0.87	1.87	0.47
Palmetto root,	1	12	0.54	1.37	0.16
Spanish moss,	1	15	0.61	0.56	0.07
White daisy,	1	15	0.26	1.18	0.41
IV. — VEGETABLES, FRUITS, ETC.					
Apples,	2	78	0.12	0.17	0.01
Artichokes,	1	78	0.46	0.48	0.17

[1] Too high; 1.90 nearer correct.
[2] Evidently below normal.
[3] Too low; 1.80 nearer correct.

B. Fertilizer Ingredients of Fodder Articles — *Continued.*

	Number of Analyses.	Water.	Nitrogen.	Potash.	Phosphoric Acid.
IV. — Vegetables, Fruits, etc. — *Con.*					
Beets, red,	8	88.0	0.24	0.44	0.09
Sugar beets,	4	86.0	0.24	0.52	0.11
Yellow fodder beets,	1	89.0	0.23	0.56	0.11
Mangolds,	3	88.0	0.15	0.34	0.14
Carrots,	3	89.0	0.16	0.46	0.09
Cranberries,	1	89.0	0.08	0.10	0.03
Parsnips,	1	80.0	0.22	0.62	0.19
Potatoes,	5	80.0	0.29	0.51	0.08
Japanese radish,	1	93.0	0.08	0.40	0.05
Turnips,	4	90.0	0.17	0.38	0.12
Ruta-bagas,	3	89.0	0.19	0.49	0.12
V. — Concentrated Feeds.					
(*a*) *Protein.*					
Red adzinki bean,	1	14.0	3.27	1.55	0.95
White adzinki bean,	1	14.0	3.45	1.53	1.00
Saddle bean,	1	14.0	2.08	2.09	1.49
Soy bean,	3	14.0	5.61	2.12	1.82
Blood meal (Armour's),	1	11.0	13.55	0.18	0.26
Brewer's dried grains,	2	8.0	3.68	0.86	1.06
Cotton-seed meal,	130	7.0	7.16	2.01	2.86
Distillers' dried grains,	20	8.0	4.50	0.31	0.61
Gluten feed,	72	8.5	4.17	0.37	0.72
Gluten meal,	46	9.5	5.87	0.21	0.55
Linseed meal (new process),	21	9.0	5.97	1.42	1.79
Linseed meal (old process),	43	8.5	5.32	1.29	1.64
Malt sprouts,	12	11.0	4.32	2.00	1.56
Bibby's dairy cake,	1	10.0	2.94	1.67	2.07
Sucrene feed,	1	10.0	2.62	2.08	0.55
Pea meal,	1	10.0	3.04	0.98	1.81
Peanut meal,	1	8.0	7.84	1.54	1.27
Proteina,	1	8.0	3.04	0.58	1.02
Rye feed,	11	11.0	2.36	1.08	1.60
Wheat middlings (flour),	32	10.0	3.16	1.05	1.66
Wheat middlings (standard),	77	10.0	2.92	1.28	2.04
Wheat mixed feed,	223	10.0	2.76	1.43	2.57
Wheat bran,	98	10.0	2.63	1.40	2.82

B. FERTILIZER INGREDIENTS OF FODDER ARTICLES—*Concluded.*

	Number of Analyses.	Water.	Nitrogen.	Potash.	Phosphoric Acid.
V.—CONCENTRATED FEEDS—*Con.*					
(*b*) *Starchy.*					
Ground barley,	1	13.0	1.56	0.34	0.66
Buckwheat hulls,	1	12.0	0.49	0.52	0.07
Cocoa dust,	1	7.0	2.30	0.63	1.34
Corn cobs,	8	8.0	0.52	0.63	0.06
Corn and cob meal,	29	11.0	1.38	0.46	0.56
Corn kernels,	13	11.0	1.82	0.40	0.70
Corn meal,	3	14.0	1.92	0.34	0.71
Corn and oat feed (Victor),	2	10.0	1.38	0.61	0.59
Corn, oat and barley feed (Schumachers),	1	8.0	1.80	0.63	0.83
Cotton hulls,	3	11.0	0.75	1.08	0.18
Hominy meal,	49	11.0	1.66	0.78	1.25
Common millet seed,	2	12.0	2.00	0.45	0.95
Japanese millet seed,	1	12.0	1.58	0.35	0.63
Molasses (Porto Rico),	1	24.0	0.51	3.68	0.12
Dried molasses beet pulp,	1	8.0	1.60	1.47	0.16
Oat kernels,	1	11.0	2.05	–	–
Oat feed,	14	7.0	1.26	0.75	0.48
Oat feed (low grade),	15	7.0	0.88	0.70	0.35
Peanut feed,	2	10.0	1.46	0.79	0.23
Peanut husks,	1	13.0	0.80	0.48	0.13
Louisiana rice bran,	1	11.0	1.42	0.83	1.70
Rye middlings,	1	11.0	1.87	0.82	1.28
Damaged wheat,	1	13.0	2.26	0.51	0.83
Wheat flour,	2	12.0	2.02	0.36	0.35
(*c*) *Poultry.*					
American poultry food,	1	8.0	2.22	0.52	0.98
Meat and bone meal,	10	6.0	5.92	–	14.68
Meat scraps,	4	9.0	7.63	–	8.11
VI.—DAIRY PRODUCTS.					
Whole milk,	297	86.4	0.57	0.19 [1]	0.16 [1]
Human milk,	3	88.1	0.24	–	–
Skim milk,	22	90.3	0.59	0.18 [2]	0.20 [2]
Buttermilk,	1	91.1	0.51	0.05	0.04
Whey,	1	93.7	0.10	0.07	0.17
Butter,	117	12.5	0.19	–	–

[1] From Farrington and Woll.   [2] From Woll's Handbook.

C. Analyses of Dairy Products.

[Per Cent.]

Name.	Number of Analyses.	Solids.			Fat.			Proteids (N. × 6.25).	Salt.	Ash.
		Maximum.	Minimum.	Average.	Maximum.	Minimum.	Average.			
Whole milk,	4,103 [1]	19.55	10.02	13.63	10.70	1.50	4.43	3.56 [2]	-	0.73
Human milk,	3	13.59	10.50	11.87	3.77	1.66	2.52	1.48	-	0.24
Colostrum,	2	24.75	21.25	23.00	3.00	3.00	3.00	2.84 [4]	-	1.00
Skim milk (largely from Cooley process),	358	10.48	7.68	9.20	1.80	0.05	0.32	-	-	-
Buttermilk,	31	9.86	6.83	8.33	0.38	0.11	0.27	-	-	-
Cream (from Cooley process),	203	32.78	18.12	26.10	25.00	10.53	17.60	-	-	-
Butter (salted),	149	94.84	82.55	87.28	89.33	75.94	83.04	1.10 [5]	3.14	-
Butter (fresh),	14	85.36	72.49	82.24	85.05	72.21	81.48	0.76	-	-
Milk powder (Creamora), one-third skimmed,	1	-	-	93.49	-	-	24.96	23.78	-	6.93
Milk powder (Milcora), skim milk,	1	-	-	90.17	-	-	0.38	30.89	-	8.88

[1] Largely station herd, Jersey blood predominating. [2] Average of 331 samples. [3] Average of 259 samples. [4] Nitrogen. [5] Curd and natural ash.

Coefficients of Digestibility of American Feed Stuffs. — Experiments made in the United States.[1]

J. B. LINDSEY AND P. H. SMITH.

Experiments with Ruminants.
Experiments with Swine.
Experiments with Horses.
Experiments with Poultry.
Experiments with Calves.

Complete through Dec. 31, 1905.

[1] Being a portion of the report of the Division of Foods and Feeding.

EXPERIMENTS WITH RUMINANTS.

KIND OF FODDER.	Number of Different Lots.	Single Trials.	Dry Matter (Per Cent.).	Organic Matter (Per Cent.).	Crude Ash (Per Cent.).	Crude Protein (Per Cent.).	Crude Fibre (Per Cent.).	Nitrogen-free Extract (Per Cent.).	Crude Fat (Per Cent.).
I. — GREEN FODDERS.									
(a) Meadow Grasses and Millets.									
Grass, meadow, young,	1	1	69	–	–	65	71	72	55
Grass, meadow, young, dried,	1	1	71	–	–	71	77	73	60
Grass, timothy,	1	3	63—65 64	– –	31—33 32	48—48 48	54—58 56	65—67 66	52—54 52
Grass, timothy, rowen,	1	2	– –	65—67 66	– –	72—72 72	60—68 64	67—68 68	51—55 52
Barnyard millet in blossom (Massachusetts),	3	6	67—76 70	– –	45—67 56	58—70 65	71—77 73	65—77 71	54—67 58
Japanese millet, bloom to early seed (Storrs),	2	3	– –	62—66 64	52—58 55	45—57 50	59—63 62	61—68 67	60—72 68
Hungarian grass, early to late bloom,	3	8	61—71 66	61—74 68	– –	59—72 63	65—76 70	61—71 67	18—85 62
(b) Cereal Fodders.									
Barley fodder, bloom,	2	4	– –	62—71 67	– –	69—73 72	49—66 61	69—76 71	56—63 60
Barley fodder, seeds forming,	2	2	– –	66—71 68	40—44 42	67—71 69	47—65 56	71	48—50 49
Corn fodder, dent, immature,	5	14	64—71 68	– –	12—43 42	56—80 66	56—76 65	64—79 71	37—83 68

EXPERIMENTS WITH RUMINANTS — *Continued.*

KIND OF FODDER.	Number of Different Lots.	Single Trials.	Dry Matter (Per Cent.).	Organic Matter (Per Cent.).	Crude Ash (Per Cent.).	Crude Protein (Per Cent.).	Crude Fibre (Per Cent.).	Nitrogen-free Extract (Per Cent.).	Crude Fat (Per Cent.).
1. — GREEN FODDERS — *Con.*									
(*b*) *Cereal Fodders* — Con.									
Corn fodder, dent, milk,	3	9	70	-	-	61	64	76	78
Corn fodder, dent, mature,	9	17	68	72	34	53	57	73	74
Corn fodder, dent, mature, B. & W., coarse,	1	2	51—54 52	- -	- -	20—28 24	46—47 46	57—61 59	74—82 78
Corn fodder, Eureka silage, ears just forming,	1	3	64—69 67	- -	42—43 42	67—68 67	56—61 60	70—74 72	65—67 66
Corn fodder, Sanford, mature,	2	4	63—73 69	67—75 71	14—50 34	46—57 52	67—80 75	67—75 71	53—74 66
Corn fodder, sweet, milk stage,	1	2	77—78 77	- -	- -	77—78 77	74—76 75	80—81 81	73—74 74
Corn fodder, sweet, roasting stage,	9	12	- -	67—79 72	22—61 48	52—69 62	54—72 60	73—82 77	62—82 74
Oat fodder, bloom to early seeding,	3	5	- -	56—65 62	49—68 60	68—76 73	43—63 55	60—67 62	67—72 69
Rye fodder, heading,	1	2	73—74 74	- -	- -	79—80 79	80—80 80	70—71 71	74—74 74
Sorghum fodder, blossom,	1	2	73—73 73	- -	- -	51—56 53	74—75 75	78—78 78	81—82 81

Sorghum fodder, Early Amber, past blossom,	1	2	61—62 61	- -	- -	38—42 40	42—45 42	70—71 71	- 67
Sorghum fodder, average both samples,	2	4	67	-	-	46	59	74	74
(c) Legumes.									
Alfalfa fodder,	1	2	61—61 61	- -	40—40 40	73—75 74	42—43 43	71—72 72	38—39 39
Soy beans, variety uncertain, before bloom,	1	2	- -	64—67 66	- -	77—80 79	45—55 50	71—73 72	50—58 54
Soy beans, variety uncertain, seeding,	1	2	- -	61—63 62	- -	68—71 69	38—43 41	72—75 73	49—59 54
Soy beans, medium green, full blossom,	1	2	- -	62—63 63	22—28 25	76—78 77	45—49 47	69—73 71	46—54 50
Soy beans, medium green, seeding,	4	12	62—69 65	65—69 67	16—45 28	74—84 78	31—53 45	71—81 77	31—69 55
Clover, crimson, late blossom,	1	3	- -	68—70 69	- -	77—77 77	54—58 56	74—75 74	63—69 66
Clover, red, late blossom,	1	2	65—67 66	- -	- -	66—68 67	52—53 53	76—79 78	63—66 65
Clover, rowen, late blossom,	1	2	- -	60—62 61	- -	61—62 62	51—54 52	64—68 65	60—61 61
Clover, average two samples,	2	4	65—67 66	60—62 61	- -	61—68 65	51—54 53	64—79 72	60—66 63
Cowpeas, ready for soiling,	2	4	66—77 68	72—76 74	19—28 23	73—77 76	57—62 60	76—84 81	56—62 59
Canada field peas, before bloom,	1	2	68 -	71—72 71	- -	81—83 82	62—62 62	71—71 71	50—55 52
Canada field peas, bloom to seeding,	2	6	60—67 64	- -	26—45 37	79—83 81	40—52 45	72—80 76	45—64 55

Experiments with Ruminants — *Continued.*

Kind of Fodder.	Number of Different Lots.	Single Trials.	Dry Matter (Per Cent.).	Organic Matter (Per Cent.).	Crude Ash (Per Cent.).	Crude Protein (Per Cent.).	Crude Fibre (Per Cent.).	Nitrogen-free Extract (Per Cent.).	Crude Fat (Per Cent.).
I. — Green Fodders — *Con.*									
(*c*) *Legumes* — Con.									
Spring vetch (*Vicia sativa*),	1	2	62—62 62	- -	- 17	71—72 71	42—46 44	75—77 76	57—60 59
Winter or hairy vetch (*Vicia villosa*, bloom,	4	14	66—78 71	- -	29—55 42	79—88 83	52—73 63	68—84 77	63—82 71
(*d*) *Mixed and Miscellaneous.*									
Apple pomace,	2	6	66—80 72	- -	24—63 49	- -	36—85 65	80—90 85	39—52 46
Barley and peas, bloom,	3	4	- -	55—71 65	52—55 54	73—81 75	38—61 52	56—76 68	54—65 59
Oats and spring vetch, bloom,	1	3	65—69 67	- -	49—55 53	73—76 75	65—72 68	66—70 68	42—52 47
Oats and peas, bloom,	2	5	69—72 70	67—69 68	45—52 49	68—82 74	54—70 64	66—77 72	51—74 64
Oats and peas, partly seeded,	3	5	- -	58—70 62	36—63 47	68—83 74	48—67 55	56—67 63	55—74 64
Dwarf Essex rape, first growth,	1	2	88—88 88	- -	76—77 76	90—91 90	90—90 90	94—94 94	54—55 54
Dwarf Essex rape, second growth,	1	2	81 -	- -	47—51 49	86—89 87	84—84 84	90—91 90	42—44 43
Dwarf Essex rape, average,	2	4	85	-	63	89	87	92	48
Winter wheat and hairy vetch,	2	5	68—71 69	- -	40—46 44	69—78 75	66—71 68	71—76 73	54—61 57

II. — SILAGE.									
Soy bean silage, goats,	1	2	52—66 59	- -	- -	71—80 76	47—62 55	46—58 52	66—77 72
Soy bean silage, steers,	1	2	50—50 50	- -	- -	54—56 55	42—44 43	61—61 61	47—52 49
Soy bean silage, mammoth yellow, bloom,	1	3	52—65 58	63—73 67	- -	57—69 61	51—67 59	74—80 76	48—60 52
Soy bean silage, average,	3	7	56	67	-	66	53	65	57
Soy bean and barnyard millet silage,	1	4	54—65 59	- -	- -	55—62 57	61—73 69	54—63 59	69—75 72
Soy bean and corn silage (9 beans, 14 corn),	4	8	62—73 69	71—75 72	39—48 42	54—68 63	51—73 62	73—81 78	67—91 83
Clover silage,	2	5	32—52 44	36—54 45	26—51 36	22—40 35	41—55 48	31—56 45	36—60 45
Corn silage, dent, immature, average all trials,	7	17	59—68 64	60—68 64	31—35 33	42—65 53	54—78 68	60—70 66	61—85 71
Corn silage, dent, mature, average all trials,	9	25	57—76 66	60—77 70	24—48 37	21—63 50	45—80 64	63—83 71	65—90 82
Corn silage, dent, Leaming, immature,	2	4	59—66 62	60—68 64	31—35 33	46—51 49	54—71 63	62—66 65	61—77 72
Corn silage, dent, Pride of the North, mature,	1	2	72—76 74	- -	24—28 26	- 45	72—73 73	81—83 82	72—82 77
Corn silage, dent, Virginia, mature,	1	4	57—74 64	60—75 66	- -	21—55 39	51—69 58	66—79 72	65—84 77
Corn silage, Sanford, ears glazing,	1	2	74—76 75	76—77 77	47—48 48	54—54 54	77—78 78	78—80 79	76—78 77
Corn silage, dent, average all trials,	16	46	64	70	37	49	65	69	77
Corn silage, flint, mature, small varieties,	4	11	68—78 75	66—80 77	- -	48—73 65	75—79 77	71—83 79	- 82

EXPERIMENTS WITH RUMINANTS — *Continued.*

Kind of Fodder.	Number of Different Lots.	Single Trials.	Dry Matter (Per Cent.).	Organic Matter (Per Cent.).	Crude Ash (Per Cent.).	Crude Protein (Per Cent.).	Crude Fibre (Per Cent.).	Nitrogen-free Extract (Per Cent.).	Crude Fat (Per Cent.).
II. — SILAGE — *Con.*									
Corn silage, flint, large white, partly eared,	1	2	69—70 / 70	72—73 / 72	31—37 / 34	56—56 / 56	72—72 / 72	75—76 / 76	72—74 / 73
Corn silage, fine crushed, steers,	1	2	60—68 / 64	- / -	- / -	32—44 / 38	72—78 / 75	60—70 / 65	75—77 / 76
Corn silage, fine crushed, sheep,	1	2	51—56 / 54	- / -	- / -	21—22 / 21	59—68 / 64	53—57 / 55	67—69 / 68
Corn silage, mature, fed raw,	1	1	-	-	-	45	59	71	86
Corn silage, mature, cooked,	1	1	-	-	-	39	70	75	87
Corn silage, steamed,	1	2	73—74 / 73	75—76 / 76	46—50 / 48	53—57 / 55	75—76 / 76	75—77 / 76	90—90 / 90
Corn silage, sweet, mature,	1	2	67—70 / 68	68—72 / 70	- / -	53—55 / 54	68—74 / 71	71—73 / 72	82—85 / 83
Kaffir corn silage, well matured,	1	3	54—56 / 55	56—59 / 57	- / -	22—33 / 28	57—59 / 57	59—62 / 62	47—54 / 50
Oat and pea silage,	1	2	63—68 / 65	63—70 / 67	52—53 / 52	74—75 / 75	58—65 / 61	64—70 / 67	73—77 / 75
Cow pea silage,	1	4	59—60 / 60	- / -	- / -	57—58 / 57	50—54 / 52	72—73 / 72	62—64 / 63
Sorghum silage, well matured,	1	3	51—60 / 57	53—62 / 59	- / -	6—13 / 9	51—63 / 58	59—67 / 64	53—60 / 56
Silage, mixture of corn, sunflower heads and horse beans.[1]	1	2	64—68 / 66	66—70 / 68	40—41 / 41	60—65 / 63	56—64 / 60	71—74 / 72	75—78 / 77

Silage, mixture of corn, sunflowers (whole plant) and horse beans.[1]	1	2	64—67 65	68—71 69	20—31 26	57—59 58	63—68 65	72—75 74	72—76 74
III. — HAY AND DRY COARSE FODDERS.									
(*a*) *Meadow Grasses and Millets.*									
Kentucky blue-grass (*Poa pratensis*), bloom,	1	1	56	–	42	57	63	53	43
Canada blue-grass (*Poa compressa*), bloom,	1	2	62—63 62	– –	42—42 42	43—44 43	70—71 71	63—63 63	36—39 37
Blue-joint, bloom,	1	2	67—70 69	68—71 70	– –	68—72 70	71—73 72	66—71 69	51—53 52
Blue-joint, past bloom,	1	1	40	42	–	57	37	43	37
Buffalo grass (*Bulbilis Dactyloides*),	1	1	55	–	6	54	65	62	62
Chess or cheat (*Bromus secalinus*),	1	1	45	–	23	42	46	49	32
Colorado upland hay (largely *Agropyrum tenerum*).	2	6	47—63 56	45—59 52	40—48 43	58—67 62	54—63 59	49—66 57	16—53 34
Crab grass (*Eragrostis Neo Mexicana*), ripe,	3	8	47—57 53	– –	29—52 43	30—56 58	50—66 60	50—59 53	30—52 43
Meadow fescue (*Festuca elatior pratensis*), bloom.	1	2	60—61 61	– –	– 46	51—53 52	– 67	58—60 59	53—54 54
Johnson grass (*Andropogon halepensis*),	2	3	57	–	–	40	68	57	38
Millets. Barnyard millet, well headed,	1	3	57—58 57	– –	63—64 63	63—64 64	60—64 62	50—52 52	44—50 46
Millets. Barnyard millet, just heading out,	1	2	59—62 61	– –	51—52 52	56—59 58	66—71 69	55—59 57	47—49 48
Millets. Cat-tail millet (*Pennisetum spicatum*),	1	2	61—64 62	– –	– –	61—65 63	65—68 67	58—60 59	45—48 46

[1] Proportion of one acre corn, one-fourth acre sunflower heads and one-half acre horse beans.

EXPERIMENTS WITH RUMINANTS — *Continued.*

KIND OF FODDER.	Number of Different Lots.	Single Trials.	Dry Matter (Per Cent.).	Organic Matter (Per Cent.).	Crude Ash (Per Cent.).	Crude Protein (Per Cent.).	Crude Fibre (Per Cent.).	Nitrogen-free Extract (Per Cent.).	Crude Fat (Per Cent.).
III. — HAY AND DRY COARSE FODDERS — *Con.*									
(*a*) *Meadow Grasses and Millets* — Con.									
Millets. Golden millet,	1	1	54	–	31	23	56	58	49
Millets. Hungarian,	1	2	64—66 65	66—67 66	– –	– 60	67—68 68	67—67 67	– 64
Millets. Millet (*Chætochloa Italica*),	1	2	52—58 56	– –	16—32 24	30—32 31	60—66 63	52—59 56	48—52 50
Mixed grasses, rich in protein (8–10 per cent.),	15	60	54—65 60	60—66 62	37—53 47	34—65 57	49—70 60	56—67 61	41—58 50
Mixed grasses, timothy predominating,	5	10	49—59 55	51—61 58	16—36 30	37—54 47	46—50 65	56—66 59	34—57 45
Meadow, swale or swamp hay,	1	2	38—40 39	– –	– –	31—37 34	30—36 33	– 46	– 44
Tall oat grass (*Arrhenatherum elatius*), late bloom.	1	2	54—57 55	– –	39—43 41	– 51	53—57 55	56—59 58	54—58 56
Wild oat grass (*Danthonia spicata*),	2	3	60—68 64	61—69 65	– –	49—68 58	65—71 68	62—69 65	36—63 50
Orchard grass, ten days after bloom,	1	1	54	56	–	59	58	54	54
Orchard grass, stage not given,	1	2	57—60 59	– –	– –	60—60 60	60—67 64	55—57 56	55—57 56
Orchard grass, average both samples,	2	3	56	56	–	60	61	55	55
Pasture grass,	1	3	73	73	52	73	76	74	67

	Prairie grass (*Sporobolus Asper*),	1	1	56	–	25	18	61	61	57
	Red-top,	2	3	58—62 60	59—64 61	– –	60—62 61	61—62 61	59—65 62	44—59 51
	Rowen, mixed grasses,	3	12	– –	63—68 65	– –	– 70	62—72 66	60—69 65	44—51 47
	Rowen, chiefly timothy,	1	4	– –	62—67 64	– –	66—69 68	62—73 66	60—65 63	48—51 49
	Rowen, average all trials,	4	16	–	65	–	69	66	64	47
Salt hays.	Black grass (*Juncus Geradi*),	2	5	50—62 56	– –	67—71 69	53—63 58	50—66 59	46—59 52	37—51 44
	Branch grass (*Distichlis spicata*),	2	5	49—57 52	– –	– 58	– 56	48—57 54	45—55 49	27—42 35
	Flat sage (*Spartina stricta maritima var.*),	1	3	55—58 57	– –	61—62 62	50—55 52	60—61 60	54—57 55	33—40 36
	Fox grass (*Spartina patens*),	3	7	51—56 54	– –	57—59 58	56—63 60	46—60 53	51—55 53	17—51 36
	Salt hay mixture, fox and branch grasses, etc.,	1	2	52—56 54	– –	68—70 69	41—43 42	54—61 58	51—54 52	26—30 28
	Timothy, in bloom,	4	8	54—66 59	51—67 58	33—34 34	50—60 57	50—62 57	57—72 63	26—62 48
	Timothy, past bloom,	8	17	47—61 52	43—62 52	30—68 59	32—50 43	32—57 46	53—70 59	23—70 51
	Timothy, stage unknown,	1	4	57—62 59	57—62 59	47—54 50	38—41 40	– –	– –	– –
	Timothy, average all trials,	24	58	55	56	39	48	50	62	50
	Timothy fed with cotton-seed meal (16 hay, 1 meal).	1	2	52—56 54	– –	17—28 22	24—32 28	46—52 49	61—63 62	36—37 36
	Timothy fed with cotton-seed meal (12 hay, 1 meal).	1	2	49—55 52	– –	9—30 20	27—38 32	43—51 47	58—62 60	52—54 53

EXPERIMENTS WITH RUMINANTS — *Continued.*

KIND OF FODDER.	Number of Different Lots.	Single Trials.	Dry Matter (Per Cent.).	Organic Matter (Per Cent.).	Crude Ash (Per Cent.).	Crude Protein (Per Cent.).	Crude Fibre (Per Cent.).	Nitrogen-free Extract (Per Cent.).	Crude Fat (Per Cent.).
III. — HAY AND DRY COARSE FODDERS — *Con.*									
(*a*) *Meadow Grasses and Millets* — Con.									
Timothy fed with cotton-seed meal (8 hay, 1 meal), .	1	2	44—48 46	- -	3—10 6	18—23 21	40—44 42	53—56 54	42—45 44
Timothy fed with cotton seed meal (4 hay, 1 meal), .	1	2	45—46 46	- -	- -	4—4 4	42—43 43	56—75 57	44—66 55
Timothy fed with cotton-seed meal (2 hay, 1 meal), .	1	2	48—56 52	- -	- 13	- 13	34—44 39	65—71 68	72—74 73
Timothy fed with cotton-seed meal (1 hay, 1 meal), .	1	2	47—52 49	- -	19—23 21	- -	24—26 25	68—78 73	79—87 83
Timothy fed with cotton-seed meal, average all trials,	6	12	50	-	16	20	41	62	57
Timothy and clover, poorly cured, ...	1	2	54—55 55	- -	- -	37—38 38	52—54 53	- 60	- 58
Timothy and red-top, late bloom, ...	1	7	48—60 54	- -	11—24 19	35—43 39	49—63 55	55—66 60	28—51 42
Witch grass (*Triticum repens*), ...	2	4	60—63 61	61—64 62	- -	49—64 58	56—68 62	62—70 66	54—60 57
(*b*) *Cereal Fodders.*									
Barley hay, ...	1	4	59	62	-	65	62	63	41
Corn fodder, dent, immature, average all trials, .	6	15	51—70 62	51—71 63	39—47 43	20—67 50	45—77 67	55—70 62	44—84 65
Corn fodder, dent, immature, B. & W., ...	1	4	51—64 57	- -	- -	20—36 27	45—74 59	57—66 61	66—84 76

Corn fodder, dent, in milk,	5	11	59—66 63	- -	- -	44—51 50	50—71 64	61—69 66	67—79 75
Corn fodder, dent, mature,	10	30	57—70 66	- -	16—30 23	30—61 45	43—73 63	61—81 73	56—82 70
Corn fodder, flint, ears forming,	1	3	69—72 70	71—73 71	- -	69—73 70	72—73 72	71—73 71	63—71 67
Corn fodder, flint, mature,	5	11	63—73 70	- -	- -	56—79 64	69—80 76	63—78 71	59—79 71
Corn fodder, sweet, mature,	3	6	60—71 67	62—74 70	- -	54—73 64	70—77 74	57—73 68	63—71 74
Corn stover, dent, Pride of the North,	1	2	53—55 54	- -	29—33 31	45—45 45	58—63 61	53—55 54	63—66 65
Corn stover, Eureka silage, ears just forming,	2	4	54—64 59	- -	40—46 43	57—58 53	56—72 65	53—64 59	62—67 65
Corn stover, average all trials,	11	31	53—64 57	49—58 55	29—46 41	11—58 36	52—74 64	53—64 59	49—77 67
Corn stover, below ear,	1	2	64—69 67	- -	- -	15—27 21	71—75 74	65—73 69	79—80 80
Corn stover, above ear,	1	2	52—58 55	- -	- -	17—27 22	69—72 71	50—57 54	62—65 64
Corn stover, minus pith (by hand),	1	3	54—57 55	55—59 57	- -	16—28 20	60—65 63	55—58 57	70—75 72
Corn stover, minus pith, ground (Marsden's process),	1	3	63—64 63	- -	46—55 49	57—62 60	60—61 61	65—66 66	82—83 83
Corn stover, minus pith, ground (Marsden's process), steamed.	1	3	51—59 56	- -	47—55 50	59—60 60	37—51 48	57—62 59	70—85 80
Corn stover, minus pith, average,	3	9	51—64 58	55—59 57	46—55 50	16—62 47	37—65 57	55—66 61	70—85 78
Corn stover, blades and husks,	1	4	60—68 65	- -	15—35 23	41—55 48	67—76 73	64—71 66	53—64 58

EXPERIMENTS WITH RUMINANTS — *Continued.*

Kind of Fodder.	Number of Different Lots.	Single Trials.	Dry Matter (Per Cent.).	Organic Matter (Per Cent.).	Crude Ash (Per Cent.).	Crude Protein (Per Cent.).	Crude Fibre (Per Cent.).	Nitrogen-free Extract (Per Cent.).	Crude Fat (Per Cent.).
III. — HAY AND DRY COARSE FODDERS — *Con.*									
(*b*) *Cereal Fodders* — Con.									
Corn stover, tops and blades,	1	2	59—60 60	– –	– –	54—57 55	71—72 71	62—63 62	71—72 71
Corn stover, leaves,	1	2	55—56 56	– –	– –	43—69 56	54—67 61	57—61 59	61—65 63
Corn stover, leaves,	1	2	62—67 65	– –	– –	28—41 35	75—80 78	66—70 68	52—59 56
Corn stover, leaves, average both trials,	2	4	55—67 61	– –	– –	28—69 46	54—80 70	57—70 64	52—65 60
Corn stover, husks,	1	2	71—73 72	– –	– –	24—35 30	78—81 80	– 75	23—42 33
Kaffir corn fodder,	1	4	59—62 61	– –	5—11 8	34—42 38	56—63 60	64—68 66	57—67 61
Kaffir corn stover, shredded,	1	4	54—58 56	– –	13—26 19	29—34 30	65—69 67	56—60 58	77—81 79
Kaffir corn stover,	1	1	63	–	43	50	67	67	60
Kaffir corn stover, average both trials,	2	5	57	–	24	34	67	60	75
Oat hay, bloom to milk,	2	6	51—59 55	50—61 55	35—54 45	47—66 57	54—71 58	47—58 53	44—65 53
Oat hay, milk to dough,	4	14	48—60 54	48—61 54	20—54 37	34—60 52	39—62 48	49—62 56	52—72 64
Oat hay, average all trials,	6	20	54	54	39	53	51	55	60

Oat straw,	1	2	49—52 50	51—53 52	– –	– –	57—58 58	52—55 53	35—41 38
Sorghum fodder, Minnesota Early Amber,	1	3	58—60 58	54—55 54	41—49 44	40—47 43	42—56 49	57—67 61	62—67 65
Sorghum fodder, leaves,	1	2	60—66 63	– –	– –	59—62 61	65—76 70	62—67 65	46—47 47
Sorghum fodder, bagasse,	1	1	61	–	–	14	64	65	46
(c) Legumes.									
Alfalfa, first crop, budded to full bloom,	8	17	56—72 63	– –	34—67 58	61—84 71	31—65 49	68—76 72	23—61 41
Alfalfa, second crop, budded to full bloom,	6	12	58—67 62	– –	38—59 51	64—81 73	41—49 45	70—79 73	34—48 42
Alfalfa, third crop,	1	2	56—60 58	– –	40—49 44	68—70 69	28—40 34	71—71 71	38—45 42
Alfalfa, average three crops,	15	31	62	–	54	72	47	72	41
Alfalfa, average all trials,	21	39	62	–	53	72	47	72	43
Soy bean,	1	2	62—63 62	– –	– –	70—72 71	59—62 61	66—71 69	19—40 29
Clover, alsike, full to late bloom,	4	9	55—64 59	56—65 60	– 42	64—71 66	40—59 50	59—74 66	21—69 38
Clover, crimson,	3	9	57—65 62	52—58 56	– –	64—73 69	32—58 45	52—74 62	29—54 44
Clover, red,	7	18	49—67 57	51—66 54	0—41 30	47—69 58	42—70 51	56—72 61	40—70 55
Clover, white,	1	1	66	67	–	73	61	70	51
Clover, rowen,	2	4	– –	58—60 59	42—50 46	60—69 65	45—51 47	62—64 63	58—60 60

EXPERIMENTS WITH RUMINANTS — *Continued.*

Kind of Fodder.	Number of Different Lots.	Single Trials.	Dry Matter (Per Cent.).	Organic Matter (Per Cent.).	Crude Ash (Per Cent.).	Crude Protein (Per Cent.).	Crude Fibre (Per Cent.).	Nitrogen-free Extract (Per Cent.).	Crude Fat (Per Cent.).
III. — HAY AND DRY COARSE FODDERS — *Con.*									
(c) *Legumes* — Con.									
Cow pea,	1	2	– 59	– –	– –	64—65 65	41—45 43	– 71	46—54 50
Peanut vine,	1	2	59—60 60	– –	– –	63—64 63	51—53 52	69—70 70	62—70 66
Spring vetch (*Vicia sativa*),	1	2	65—67 66	66—68 67	52—53 53	69—71 70	54—61 58	71—72 72	70—72 71
Winter or hairy vetch (*Vicia villosa*),	1	6	68—71 69	– –	34—46 42	81—83 82	60—63 61	71—75 73	69—74 70
(d) *Mixed and Miscellaneous.*									
Buttercups (*Ranunculus acris*),	1	2	56	57	–	56	41	67	70
Cotton-seed feed (4 to 1),[1] sheep,	2	6	54—60 56	– –	23—35 28	36—45 41	51—60 56	57—60 59	86—94 91
Cotton-seed feed (5 to 1), steers,	1	3	42—45 43	– –	20—24 22	32—41 36	28—33 31	50—59 54	83—86 84
Cotton-seed feed (7 to 1) and (6 to 1), steers,	1	3	45—46 46	– –	– 28	44—46 45	34—40 37	50—51 50	81—82 82
Cotton-seed feed (4 to 1), steers,	1	2	54	–	46	54	45	58	85
Cotton-seed feed (3 to 1) to (2 to 1), steers,	2	9	54	–	32	64	47	54	85
Cotton-seed feed, average both (4 to 1) trials,	3	8	56	–	33	44	53	59	90

Cotton-seed feed, average all trials,	7	23	52	–	30	51	46	55	83
Cotton-seed hulls,	4	13	35—47 41	– –	– –	0—25 6	0.5—58 47	13—46 34	58—89 73
Oats and peas,	2	7	56—67 61	56—67 60	54—65 58	69—78 73	50—64 58	54—66 61	51—69 59
Oats and sand vetch,	1	2	55—55 55	56—56 56	43—46 44	64—66 65	48—50 49	58—59 59	58—67 63
Oats and spring vetch,	2	5	57—63 59	– 60	– 60	60—71 65	47—67 57	34—65 50	17—76 52
Oats and vetch, average,	3	7	58	58	56	65	55	59	55
Salt bush (*Atriplex Argentea*),	1	3	46—47 46	31—32 31	71—72 72	65—68 66	3—15 8	46—51 49	50—55 52
Wheat and sand vetch,	2	6	61—69 66	– –	33—60 47	70—77 74	63—66 65	67—71 68	62—67 64
White weed (*Leucanthemum vulgare*),	1	2	58	58	–	58	40	67	62
IV. — ROOTS AND TUBERS.									
Sugar beets,	1	2	94—96 95	98—100 99	– –	90—93 91	88—113 100	100—100 100	40—53 [illegible]
Mangolds,	1	2	77—80 79	83—87 85	– –	70—80 75	27—59 43	91—92 91	–
Potatoes,	1	3	73—80 77	75—81 78	– –	43—45 44	–	87—95 91	– 15
Ruta-bagas,	1	2	84—90 87	89—93 91	– –	75—86 80	61—87 74	94—96 95	77—92 84
English flat turnips,	1	2	91—95 93	93—99 96	– –	84—96 90	83—117 100	96—97 97	82—92 88

¹ Four hulls to one meal.

EXPERIMENTS WITH RUMINANTS — *Continued.*

KIND OF FODDER.	Number of Different Lots.	Single Trials.	Dry Matter (Per Cent.).	Organic Matter (Per Cent.).	Crude Ash (Per Cent.).	Crude Protein (Per Cent.).	Crude Fibre (Per Cent.).	Nitrogen-free Extract (Per Cent.).	Crude Fat (Per Cent.).
V.—CONCENTRATED FEED STUFFS.									
(a) Protein.									
Soy bean meal, variety unknown,	2	3	75—79 78	- -	- -	89—91 90	0—73 33	68—73 71	81—98 89
Soy bean meal, medium green, coarse ground,	2	4	81—98 90	- -	42—77 57	88—95 91	- -	61—100 81	89—97 93
Bibby's dairy cake,	2	6	61—81 70	- -	18—44 33	58—76 66	1—68 46	71—88 81	84—99 92
Blood meal, Armour's,	1	2	- -	- -	- -	80—88 84	- -	- -	- -
Brewers' dried grains,	2	5	56—62 62	- -	- -	78—84 81	28—62 49	51—60 57	87—93 89
Buckwheat middlings,	1	3	71—79 75	- -	26—41 36	83—86 85	8—26 17	79—87 83	87—92 89
Cotton-seed, raw,	1	2	63—69 66	- -	- -	66—70 68	65—86 76	49—50 50	- 87
Cotton-seed, roasted,	1	2	53—58 56	- -	- -	44—50 47	62—69 66	50—53 51	68—75 72
Cotton-seed meal,	4	12	67—90 79	81—95 88	- 84	76—96 84	26—55 35	66—96 78	87—100 94
Cotton-seed meal, high grade (Maine),	1	2	90	95	-	83	-	96	100
Cotton-seed meal, medium grade (Maine),	1	2	67—79 73	73—83 78	- -	81—86 84	40—47 44	73—91 82	95—95 95

Cotton-seed meal, low grade (Maine),	1	2	60—63 62	62—67 65	- -	72—73 73	30—45 38	66—70 68	87—93 90
Cotton-seed meal, high grade, dark colored, slightly fermented (Maine).	1	2	81—91 86	85—95 90	- -	82—83 83	- -	90—100 95	95—100 98
Dairy feed, H-O,	2	4	65—65 65	- -	- -	68—80 76	14—43 35	67—75 72	83—88 84
Distillers' dried grains, brand R, largely from rye,	1	2	56—59 58	- -	- -	56—63 59	- ?	61—73 67	80—88 84
Distillers' dried grains, largely from corn,	8	17	70—89 79	- -	- -	66—80 73	59—100+ 95	69—97 81	88—98 95
Germ oil meal,	2	5	72—83 76	- 75	- -	65—77 73	- -	68—82 76	95—98 96
Gluten feed,	7	13	85—91 86	92—93 93	- -	85—86 85	- 76	89—90 89	- 83
Gluten meal,	4	8	75—95 87	- -	- -	86—93 88	- -	78—94 88	91—99 93
Linseed meal, old process,	1	3	75—82 79	- -	- -	86—93 89	38—71 57	76—79 78	85—92 89
Linseed meal, new process,	1	3	73—83 78	- -	- -	82—88 85	49—100 74	82—87 84	90—98 93
Linseed meal, new process, Cleveland flax,	3	9	76—88 83	- 79	- -	- 83	- -	- 79	- 87
Linseed meal, new process, average,	4	12	82	79	-	84	74	80	89
Malt sprouts,	1	1	67	68	-	80	34	69	100
Malt sprouts (Mass.),	1	3	75—89 82	- -	3—33 19	74—77 76	98—100 99	76—91 85	74—100 87
Maize feed (Chicago),	1	2	83—85 84	- -	- -	83—84 84	68—76 72	84—87 85	90—90 90

EXPERIMENTS WITH RUMINANTS — *Continued.*

KIND OF FODDER.	Number of Different Lots.	Single Trials.	Dry Matter (Per Cent.).	Organic Matter (Per Cent.).	Crude Ash (Per Cent.).	Crude Protein (Per Cent.).	Crude Fibre (Per Cent.).	Nitrogen-free Extract (Per Cent.).	Crude Fat (Per Cent.).
V. — CONCENTRATED FEED STUFFS — *Con.*									
(*a*) *Protein* — Con.									
Oat middlings, fine,	1	2	88—91 90	– –	31—40 36	80—81 81	21—77 49	94—97 96	93—94 94
Pea meal,	1	2	85—88 87	86—89 88	– –	80—86 83	25—26 26	93—94 94	52—57 55
Cow pea meal,	1	2	85—88 87	– –	22—45 33	80—85 82	62—66 64	92—94 93	74—74 74
Rye feed, bran and middlings,	1	3	77—83 82	– –	25—48 35	78—82 80	– –	86—89 88	79—99 90
Wheat bran, spring,	3	7	62—70 67	69—74 71	20—32 25	74—82 76	22—76 44	70—80 74	38—83 63
Wheat bran, winter,	1	3	57—66 62	– –	– –	75—79 77	– 27	62—76 65	51—80 64
Wheat bran, average all trials,	4	10	66	–	–	77	39	71	63
Wheat feed flour,	1	2	67—67 67	70—70 70	– –	78—80 79	– –	73—78 76	– –
Wheat middlings, flour,	2	4	78—86 82	81—84 83	– –	82—91 88	33—40 36	84—91 88	82—88 86
Wheat middlings, standard,	2	6	–	73	25	77	30	78	88
Wheat mixed feed, bran and middlings,	2	4	71—78 73	73—81 76	34—43 37	77—79 78	47—79 62	74—79 77	81—92 87
Wheat mixed feed, adulterated with corn cobs,	1	3	59—65 62	61—67 64	28—34 31	62—63 63	17—36 28	68—74 71	91—93 92

(b) Starchy.								
Cerealine feed,	1	3	89—92 90	- -	- -	79—81 80	72—92 82	93—97 95	78—83 81
Chop feed, corn bran and germs,	2	6	71—92 80	- -	- -	56—77 67	54—70 62	64—92 84	61—86 82
Corn bran,	2	4	70—71 70	- -	- -	53—55 54	50—65 59	74—80 77	69—85 77
Corn cobs,	1	2	59—60 59	- -	- -	13—22 17	65—66 65	60—60 60	44—56 50
Corn meal, coarse,	2	4	74—93 84	75—94 86	- -	45—54 48	- -	79—91 86	- -
Corn meal, fine,	2	3	87—89 88	89—90 90	- -	48—63 54	- -	87—95 91	- -
Corn meal, average all trials,	9	21	74—98 88	75—94 90	- -	40—87 66	- -	79—100 92	71—99 91
Corn and cob meal,	1	3	74—83 79	- -	- -	43—65 52	2—86 45	86—91 88	82—85 84
Corn and oat feed, Victor,	1	3	74—76 75	- -	- -	66—75 71	36—58 48	81—85 83	84—88 87
Kaffir corn kernels,	2	6	29—58 43	- -	- -	28—54 41	- -	34—62 45	- -
Kaffir corn meal,	2	5	54—76 66	- -	- -	36—62 53	- -	67—84 77	25—62 46
White Kaffir heads,	1	4	14—35 24	- -	24—83 54	7—23 12	0—46 27	14—40 31	5—65 31
Dairy feed, Quaker,	3	8	58—64 62	- 52	- -	62—72 70	54—56 55	55—71 59	72—80 74
Hominy meal,	3	8	71—91 82	- -	11—60 37	54—74 65	2—100+ 67	82—94 89	88—95 92

EXPERIMENTS WITH RUMINANTS — *Concluded.*

KIND OF FODDER.	Number of Different Lots.	Single Trials.	Dry Matter (Per Cent.).	Organic Matter (Per Cent.).	Crude Ash (Per Cent.).	Crude Protein (Per Cent.).	Crude Fibre (Per Cent.).	Nitrogen-free Extract (Per Cent.).	Crude Fat (Per Cent.).
V. — CONCENTRATED FEED STUFFS — *Con.*									
(*b*) *Starchy* — Con.									
Horse feed, H-O,	3	5	70—77 74	– 78	– –	62—81 70	52—59 56	79—85 83	74—87 80
Molasses Feeds. Alma dried molasses beet pulp,	1	2	82—87 85	– –	55—69 62	59—69 64	83—84 84	89—93 91	– –
Molasses Feeds. Blomo feed,	1	2	64—69 67	– –	31—32 32	61—64 63	51—72 61	73—79 76	14—17 16
Molasses Feeds. Holstein sugar feed,	1	3	70—74 71	– –	24—43 33	61—71 66	26—62 44	79—82 81	86—89 88
Molasses Feeds. Macon sugar feed,	1	2	69—72 71	– –	20—21 20	57—61 59	36—51 44	81—83 82	74—91 82
Molasses Feeds. Sucrene dairy feed,	1	2	67—72 69	– –	28—47 38	57—64 61	70—73 72	71—75 73	93—96 95
Molasses Feeds. Molasses feeds, average last three,	3	7	70	–	36	63	52	80	88
Oats, unground,	2	6	66—74 70	68—74 71	2—61 25	72—81 77	15—40 31	74—79 77	87—92 89
Oat feed, Royal,	1	3	42—51 47	42—53 48	33—40 37	64—72 69	20—43 33	50—54 51	86—92 88
Oat feed, excessive hulls,	1	3	29—38 34	– –	8—21 13	51—69 62	25—37 32	29—36 33	89—97 92
Oat feed, average last two,	2	6	40	–	25	65	32	42	90
Parson's "Six-dollar" feed,	1	2	55—56 56	– –	10—14 12	56—62 59	45—50 47	63—65 64	80—81 81

Peanut feed, largely husks,	1	2	32—32 32	– –	– –	70—71 71	10—13 12	41—58 49	90—90 90
Rice meal,	1	2	71—76 74	– –	– –	– 62	– 2	89—95 92	91—92 91
Rice bran,	2	4	56—66 62	– –	1—34 18	58—68 64	13—42 21	76—81 78	52—92 72
Rye meal,	1	2	85—90 87	– –	– –	83—85 84	– –	89—94 92	63—65 64
Rice polish,	1	2	82—83 83	– –	27—36 31	65—66 66	22—23 22	92—93 93	66—81 74

EXPERIMENTS WITH SWINE.

Barley meal,	1	1	80	80	–	81	49	87	57
Linseed meal, old process,	1	4	76—79 77	– –	8—12 10	83—90 86	10—14 12	82—87 85	78—82 80
Maize kernels,	1	1	83	83	–	69	38	89	46
Maize meal,	2	2	89—90 90	91—92 92	– –	86—90 88	29—49 39	94—94 94	78—82 80
Maize meal with cobs,	1	1	76	77	–	76	29	84	82
Hog millet seed (*Panicum miliaceum*),	1	1	73	–	19	68	33	92	59
Pea meal,	1	1	90	92	–	89	78	95	50
Potatoes,	1	4	97	–	–	84	–	98	–
Wheat, whole,	1	2	72	–	–	70	30	74	60
Wheat, cracked,	1	2	82	–	–	80	60	83	70
Wheat shorts (middlings),	1	2	74—79 77	– –	– –	71—75 73	25—48 37	85—88 87	– –
Wheat bran,	1	2	54—78 66	– –	– –	74—76 75	30—39 34	56—75 66	65—78 72

Experiments with Horses.

Kind of Fodder.	Number of Different Lots.	Single Trials.	Dry Matter (Per Cent.).	Organic Matter (Per Cent.).	Crude Ash (Per Cent.).	Crude Protein (Per Cent.).	Crude Fibre (Per Cent.).	Nitrogen-free Extract (Per Cent.).	Crude Fat (Per Cent.).
Corn kernels,	1	2	71—78 74	- -	20—32 26	40—76 58	- -	85—92 88	43—52 48
Corn meal, same as above,	1	2	84—93 88	- -	- -	74—77 76	- -	93—99 96	70—76 73
Corn stover minus pith, ground (Marsden's process),	1	2	40—59 50	- -	6—37 22	65—70 68	38—71 55	39—54 47	48—72 60
Oat kernels,	1	2	67—77 72	- -	31—36 33	84—87 86	13—49 31	75—83 79	80—85 82
Oats, ground, same as above,	1	2	73—78 76	- -	9—49 29	81—83 82	0.6—28 14	85—87 86	79—81 80
Oats, average of both,	2	4	74	-	31	84	22	82	81
Timothy hay,	1	2	39—48 44	- -	29—39 34	18—24 21	37—48 43	44—50 47	44—51 47

Experiments with Poultry.

Kind of Fodder.	Number of Different Lots.	Single Trials.	Dry Matter (Per Cent.).	Organic Matter (Per Cent.).	Crude Ash (Per Cent.).	Crude Protein (Per Cent.).	Crude Fibre (Per Cent.).	Nitrogen-free Extract (Per Cent.).	Crude Fat (Per Cent.).
Corn kernels,	1	3	- -	- 86	- -	44—58 50	- -	90—96 92	88—95 92
Corn kernels,	1	5	- -	86—87 87	- -	80—87 84	1—25 15	88—91 89	81—87 85
Corn meal,	1	3	- -	- 85	- -	41—55 48	- -	91—92 91	92—94 93
Kaffir corn kernels,	1	3	- -	- 88	- -	50—55 53	17—22 20	94—98 96	71—73 74

Kaffir corn meal,	1	3	-	87	-	42—44 43	30—42 35	95—97 96	82—84 83
Meat,	1	2	-	87—87 87	-	90—91 91	-	-	86—87 87
Oats,	1	8	-	60—68 64	-	68—81 74	4—11 8	65—75 71	77—85 81
Cow peas,	1	3	-	71	-	32—48 40	2—43 18	86—88 87	87—90 89
Cow pea meal,	1	3	-	72	-	40—49 44	8—11 10	84—91 88	75—98 89
Wheat,	1	1	-	84	-	77	-	89	59

Experiments with Calves.

Whole milk,	2	8	-	-	-	90—98 95	-	-	93—99 97
Pasteurized whole milk,	2	9	-	-	-	88—95 93	-	-	91—99 95
Cooked whole milk,	1	3	-	-	-	80—91 87	-	-	92—99 95
Raw skim milk,	1	3	-	-	-	94—95 95	-	-	-
Skim milk, with sheep,	1	3	96—102 97	100	46—74 62	93—96 94	-	100	100

Literature. — The following publications have been consulted in compiling the foregoing tables of digestibility: —

Colorado Experiment Station, Bulletins 8, 93.

Connecticut (Storrs) Experiment Station, reports for 1894–96, 1898.

Illinois Experiment Station, Bulletins 43, 58.

Kansas Experiment Station, Bulletin 103.

Louisiana Experiment Station, Bulletin 77, second series.

Maine Experiment Station, reports for 1886–91, 1893, 1894, 1897, 1898, 1900; Bulletin 110.

Maryland Experiment Station, Bulletins 20, 41, 43, 51, 77, 86.

Massachusetts, Hatch Experiment Station, reports for 1895–99, 1901–05; Bulletin 50 and unpublished data.

Massachusetts, State Experiment Station, reports for 1893, 1894.

Minnesota Experiment Station, reports for 1894–96; Bulletins 26, 36, 42, 47, 80.

Mississippi Experiment Station, report for 1895.

New York Experiment Station, reports for 1884, 1888, 1889; Bulletin 141.

North Carolina Experiment Station, Bulletins 80*c*, 81, 87*d*, 97, 118, 148, 160, 172.

Oklahoma Experiment Station, Bulletins 37, 46.

Oregon Experiment Station, Bulletins 6, 47, 85.

Pennsylvania Experiment Station, reports for 1887–94, 1897, 1898, 1900–01, 1903–04.

Tennessee Experiment Station, unpublished data.

Texas Experiment Station, Bulletins 13, 15, 19.

Utah Experiment Station, Bulletins 16, 54, 58.

United States Department of Agriculture, Bureau of Animal Industry, Bulletin 56.

Wisconsin Experiment Station, report for 1889; Bulletin 3.

Wyoming Experiment Station, unpublished data.

INDEX.

INDEX.